EFFECTIVE TAILORED COMMUNICATION IN LEARNING FROM HYPERTEXT: INTRODUCING EXPANDING HYPERTEXT BASED ON INDIVIDUALS' SENSATION-SEEKING AND WORKING MEMORY CAPACITY

By

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I dedicate this dissertation to my dearest husband, Matthew C. Tedder.

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I consider, in fact, that no achievement has been made. Rather, completion of the requirements for the highest academic degree possible demonstrates the magnitude of the task for which I have yet to begin. Therefore, let my truest acknowledgement be of what stands before me, in hopes that it utterly dwarfs that which lies behind.

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This research began with recognizing the individual differences in learning from different types of computer text formats and further proposed a new perspective (tailored communication) on how we design educational materials. A new alternative hypertext (expanding hypertext) was proposed and tested.

The effects of three computer text formats of the same information were examined in terms of readers' liking and comfort with presentation style, disorientation, and recognition. Individual differences such as sensation-seeking tendency and working-memory capacity were also examined in relation to the text format effects.

General Linear Models showed that adventurous participants reported higher levels of preference in the paged hypertext than those who read the scrolling text. The expanding hypertext fell in between them. In addition, adventurous participants not only

considered the paged hypertext as the least disorienting format but also considered the scrolling text as the most disorienting or frustrating format.

Individuals' working memory capacities were found to be a significant factor on participants' recognition. For the participants who were low in working memory span, the scrolling text produced the higher recognition scores than the other two hypertexts. This difference was not shown among those with high working memory span.

Furthermore, the additional findings suggested that time (how much time each individual spends reading the given information) seems to be an important mediating factor that influences how much information is learned in the hypertext learning environment rather than cognitive overload or disorientation.

Hypertext familiarity and knowledge (HFK) exhibited several interactions with the text formats on disorientation and comfort in presentation style. Among those who were low in HFK, the paged hypertext was considered most disorientating while the expanding was the least disorientating. However, of those who were high in HFK, the paged hypertext was considered the least disorienting and most comfortable while the scrolling text was considered the most disorienting or frustrating and the least comfortable style. The female participants' recognition scores did not vary depending on the different text formats while the males' scores varied greatly. Of those who read the scrolling text, the male participants' recognition scores were higher than those of the females.

CHAPTER 1
INTRODUCTION

Unlike traditional communication mechanisms, new media technologies now enable us to tailor the format and content of messages based on the individual differences and preferences of readers. Tailored communication has the potential to change how we define the roles of mass media. Just as the advent of technologies such as the printing press, radio, and television brought us the unifying notion of broadcast media, modern computer software technologies are now returning us to concepts similar to those of the past. Multicasting and the interactively tailored content that the Internet increasingly provides may at times prove closer to interpersonal than to broadcast communication.

Our communication is no longer necessarily constrained by the traditional one-way, asymmetric communication model. Possibilities now exist to present messages that automate sophisticated interaction with readers, thus extending their capacity closer to the true meaning of symmetric communication.

The implications of these technologies are particularly great for educational purposes. The increased availability, filtering, search, and re-organization capabilities provided to the reader enable him or her to work with text in manners previously only possible within the mind itself. This is accomplished by means of electronic message presentation formats such as the various forms of hypertext. However, the format used to produce the layout of text preferred by or tailored for the reader may have different effects on his or her recall and comprehension of the material read.

In particular, tailored communication for educational purposes means that we now may be able to create more effective learning materials based on a document's ability to adapt itself to each reader's unique characteristics, needs and interests.

At the center of these new technologies are various forms of hypertext and/or hypermedia. Hypertext is a computer-mediated text in which highlighted words or titles serve as links to other excerpts or documents of supporting information. In this way, a reader can choose his or her own order and level of detail. Traditional linear text, on the other hand, is defined as a text formatted in a linear fashion from beginning to end, with no diversionary links to other excerpts or documents.

The advent of hypertext fosters nonlinear ways of learning that are no longer constrained to one specific order to follow for the presentation of information. It gives readers the ability to control the order in which information is presented. In this nonlinear learning environment, the reader has to form his or her own cohesion and sequence of information with or without a conscious cognitive effort. This may create user control of the learning process for some and cognitive overload and disorientation for others.

In this study, a new hybrid form of hypertext, called "expanding hypertext," was introduced and tested. Expanding hypertext is defined as an electronic text that shows additional excerpts or documents inserted into the same page as the hyperlink itself. It maintains the linear presentation of information but at the same time provides hypertext's flexibility to inter-link related information. In this way, readers can explore learning materials based on their needs and preferences while better facilitating cognitive

processes such as recall and comprehension by not interrupting them due to the non-linearity of hypertext learning materials.

Many scholars hypothesize that readers take an active role in finding information and in encountering different types of information in a hypertext environment (Bourne, 1990; Dee-Lucas & Larkin, 1995). However, there is considerable disagreement as to whether hypertext is beneficial for all individuals (Hammond & Allinson, 1989; Jonessen & Wang, 1990; Spiro & Jehng, 1990; Hammond, 1993; Schroeder, 1994; Dee-Lucas & Larkin, 1995; McDonald, 1998; McDonald & Stevenson, 1996).

Hypertext is being employed in a number of ways. Systematic research has been performed to discover how much better or worse readers learn from hypertext formats versus traditional text. A few additional questions have arisen from these investigations: Do any measurable characteristics of personality impact the reader's ability to understand and recall what he or she has read in this environment? What kinds of people can benefit from these new learning environments? What kinds of people might run into a problem with this particular learning environment? Where problems are found, how can we address these potential problems and produce the best learning methods based on individual needs and interests?

Personal behavioral characteristics such as sensation-seeking tendencies also might influence a reader's recall and comprehension of different texts in different ways. For example, Donohew, Palmgreen, and Duncan (1980) postulate an activation model of selective information processing based on the individual's cognitive and activation needs. They assume that individuals have different levels of arousal needs at which they are most comfortable, and that attention depends on an individual's need for stimulation by

an information source (Zillmann & Bryant, 1985); therefore, for high sensation seekers (high risk-takers), information must be novel or sensational to be effective. Learning may be enhanced if learning materials are tailored based on individual needs and interests such as these.

Individuals have different cognitive capacities. An example of this is working memory, one of the key elements of learning. Working memory is the mind's temporary memory storage area, used for initial processing of information. It is widely held that different individuals have different working memory capacities and it has been suggested that text formats influence a reader's ability to recall what is read based on working memory capacity. For example, when a text is poorly written or not well-structured, individuals with lower working memory capacity tend to experience more disorientation than those with higher working memory capacity. Therefore, researchers have hypothesized that some computer text formats or styles may be processed more easily by readers with different working memory capacities (Schroeder, 1994; Budd, Whitney, & Turley, 1995; Dee-Lucas & Larkin, 1995; Lorch, 1989).

Hypertext has the potential to interact with each reader differently. Therefore, investigating the advantages and disadvantages of different hypertext formats in relation to relevant individual characteristics and different cognitive capacities is an important step in exploring new forms of computer-mediated communication. It may, in fact, prove crucial in producing the best learning format for each individual.

This research attempted to identify a relationship between working memory capacity and different computer text formats to explore learning in a hypertext

environment. It also looked at how personal behavioral characteristics might influence individual readers' cognitive learning processes.

The purpose of this study was to investigate how text formats affect a reader's recall based on his or her working memory span and other personality or cognitive traits such as sensation-seeking tendencies. The central focus of the research was how these factors influence an individual's recognition. Further, an attempt was made to develop a theoretical model of effective computer-mediated learning based on individuals' sensation-seeking tendencies and cognitive capacity limitations.

There are four main questions in this study:

1. What are the functions and effects of different computer text formats on individuals' ability to retain information?
2. How do different computer text formats affect the ability to retain information for individuals with different working memory capacities?
3. What role does the sensation-seeking tendency of individuals play in hypertext learning environments?
4. What are the implications of these findings?

Basically, this study explored how learning with hypertext was mediated by text presentation formats, working memory, and behavioral characteristics. Finally, a new model for effective computer-mediated learning was proposed with suggestions for future research.

CHAPTER 2
LITERATURE REVIEW

Hypertext Systems for Learning

Hypertext is considered as a tool to facilitate learning (Jonassen & Grabinger, 1990; McAllese, 1991). A benefit of hypertext is the ability for the learner to skip sections of the content that he or she already knows or has no interest in and to concentrate on or more quickly reach more needed or more interesting content. In other words, hypertext allows rapid and more direct (nonlinear) access to large amounts of information and extends the users' control, giving them the freedom to explore the document according to their information needs and interests.

Liu (1992) postulates four major advantages of hypertext: nonlinearness, associativity, flexibility, and efficiency. He noted that hypertext and hypermedia have the capability of linking or relating information logically and semantically. Therefore, many educators believe that hypertext and hypermedia hold much potential for optimizing learning. Hypertext also allows the presentation of information in various modes--for example, being able to use multimedia. It can present the information in various formats, such as textual, graphic, video, and audio media (Lin & Davidson, 1996). Therefore, occasionally the term is used interchangeably with hypermedia. It gives users not only the opportunity to manipulate the order of presentation (Jonassen, 1989), but also the opportunity to modify the modality of information (i.e. visual versus

auditory). In turn, it allows a certain level of autonomy over the user's interaction with the system (Dias, Gomes, & Correia, 1999).

Many of the benefits of hypertext-based learning relate to its nonlinear and learner-control capabilities. It allows users to customize their own instructional materials through links and to incorporate visual and auditory media (Fitzgerald, 1998). However, the notion of nonlinearity is debatable because easy access does not necessarily warrant the nonlinearity of hypertext. Arguments go in two ways. First, human information processing is linear by nature. Second, the linearity of a traditional text is not definitely determined by formats of information. It depends on how individuals use a text. One example is that readers can read a traditional linear text in a nonlinear way, skipping to a specific section or excerpt by using an index or a table of contents. Similarly, hypertext can be read in a linear fashion.

Perhaps the most crucial aspect of this technology is the flexibility it offers (Shapiro, 1998). While the flexibility of hypertext has been hailed by many, the merits of using hypertext in instructional materials have spurred a considerable debate among many scholars. Hypertext places much of the responsibility of learning on an individual learner (Stevenson & Palmer, 1994). It assumes that individual learners are self-motivated and active in terms of their learning; therefore hypertext, which allows a high degree of control over their learning materials, promotes the best learning. However, some argue that this advantage tends to be overshadowed by possible disadvantages such as disorientation. Many have pointed out that hypertext users often get lost or become disoriented (Batra et al, 1993; Foss, 1989; Hammond, 1989; Hammond & Allinson, 1989; Smith & Wilson, 1993; Kim & Hirtle, 1995; McDonald & Stevenson, 1996; McDonald &

Stevenson, 1999; Unz & Hesse, 1999; Rouet, Levonen, Dillon, & Spiro,1996). It was suggested that hypertext, by causing the scrambling of an author's intended order and sudden changes in context, disorients readers (McDonald & Stevenson, 1996; Unz & Hesse, 1999). Furthermore, in this learning environment, learners tend to skip or leave out crucial information, creating fragmented knowledge (Shneiderman, 1992).

Hypertext provides users a high level of control over the sequencing of information within a text (Wenger, 1996; Dias, Gomes, & Correia, 1999). Based on learners' interests, they can navigate information through different pathways (Shin, Schallert, Savenye, 1994). However, the question of whether this type of learner control is desirable has created many debates. One problem is that students may choose to end their interaction with a system before exploring enough information for proper learning (Shin, Schallert, & Savenye, 1994). Also, the advantages of nonlinear text may be severely limited if users are unable to find their way around unfamiliar and complex information structures (McDonald, 1998).

Many studies have shown that how well students interact with a hypertext system depends on the students' prior knowledge of the subject matter (domain knowledge) or of the navigation systems (McDonald, 1998; Shin, Schallert, & Savenye, 1994). For example, Shin, Schallert, Savenye (1994) found that for students with low prior domain knowledge of content, the limited-access (traditional text) condition was more effective than the free-access condition (hypertext) for the second-grade students' comprehension and application of the concepts learned, whereas high prior knowledge students were able to function equally well in both conditions.

One of the major concerns in developing effective hypertext learning materials is in discerning how to structure hypertext to maximize the learning of readers individually. For this reason, many scholars have suggested that it is important to develop hypertexts with a transparent structure and obvious modes of information presentation styles for high usability (Nielsen, 1995). For example, is the information presented hierarchically or organized in a manner that could potentially take the reader in circles?

A problem with this approach is that considerable effort has been put within the traditional media framework without understanding the characteristics and potentials of this newer medium. The fact that hypertext has the capacity to serve each reader's needs individually calls for a new conceptual framework. It is no longer necessary to find the structure or system that maximizes learning for a collective majority. New technologies now enable us to identify and utilize more specific interactions among different hypertext formats and individual characteristics. In turn it has become possible to approach more closely the ideal of maximizing learning for all--as opposed to a collective majority.

The role of information structures should be better understood in the context of this new learning environment. Testing of various hypertext structures allows us to understand how the learning of individual readers interacts with different hypertext systems (Shapiro, 1998). Therefore, hypertext should be carefully studied to ensure the further development of effective learning materials.

Hypertext Structure

The use of hypertext for instructional materials has generated much interest among instructional material designers and educators. Because of its flexibility and the potential that learners can be served individually based on their needs, interests, and

characteristics, many scholars have investigated the relationship between different hypertext structures and individual learning. However, the results of these studies have been somewhat inconclusive, and findings have varied (Shin, Schallert, & Savenye, 1994).

It has been determined that the structure of content in a hypertext system does in fact alter learning outcomes (Shapiro, 1998). A central focus has been put on nonlinearity or the networking of information units. Conklin (1987) defined the essence of hypertext as the structure of links as a medium of thinking and communication for users. These links allow multiple paths for the exploration of materials in a hypertext system (Newmarch, 1998).

Hypertext's flexibility allows nodes and links to be arranged in a variety of information structures (McDonald, 1998). The design of hypertext learning materials always involves this link issue: Decisions about how nodes or links should be interconnected must be made, and these decisions generate different types of hypertext structures. The most frequently tested structures are hierarchical and network structures (Pohl, 1998).

Hierarchical structures connect nodes (excerpts or documents) in a hierarchical order in which a node at one level can be accessed only from nodes directly above or below it (McDonald, 1998; Shneiderman & Kearsley, 1989; Locatis, Letourneau, & Banvard, 1989; Lanza & Roselli, 1991) while network structures connect a given node to any other nodes (McDonald, 1998). In particular, learners using a network structure will necessarily have more decisions to make than learners using a hierarchical system (Misanchuk & Schwier, 1991)

Pohl (1998) observed how students created hypertext documents and found that most students tended to link between the same term on two nodes (characteristic of hierarchical structures) rather than in novel ways such as non-hierarchical structures. He also found that new electronic texts are more easily accepted and used by the students if they resemble traditional linear texts with links to explanations and examples.

Different hypertext structures offer users different levels of control (McDonald, 1998). Hierarchical structures confine learners' movements and restrict their freedom to browse, while network structures place few constraints on users' movements, giving them unlimited freedom to explore the information (McDonald, 1998). Further, this freedom seems to create an additional cognitive burden and disorientation (McDonald, 1998).

Even though user control has been noted as one benefit of hypertext, researchers have advocated the use of some form of hybrid system that incorporates hypertext with intelligent components such as adaptive links (Hammond, 1990). Adaptive links might enable a text to "recognize" a specific reader and organize itself in the structure best suited for the individual's needs or preferences.

Unstructured systems such as nonlinear or 'paged' hypertext provide little information about topic relations and so might provide the greatest opportunity for increased processing of the information. On the other hand, highly structured systems provide more information about topic relations (Shapiro, 1998). This means that highly structured systems might reduce possible disorientation for some individuals that also would limit the opportunity for individual freedom.

The research studies reviewed in the previous sections suggest three ways to improve hypertext designs. One way is to provide structural cues to the reader, the second

is to improve the coherence of information in hypertext, and the third is to provide the reader with adequate reading skills and strategies through familiarization and training procedures (Rouet & Levonen,1996). Readers have to learn specific strategies, such as knowing where they are, deciding where to go next, and building a cognitive representation of the network structure in nonlinear presentation (Rouet & Levonen1996).

Providing a hierarchical text structure is believed to be useful for learning, particularly for text comprehension and recall (Dix, Finlay, Abowd, & Beale,1993; McNamara, Hardy & Hirtle, 1989). However, studies exploring the effects of providing structure have showed conflicting results.

Providing a structural overview of how information is interconnected in a subject matter may hinder the understanding of content among those with low domain knowledge (Hofman, van Oostendorp, & Herre, 1999). One problem with providing highly structured learning materials is that there is less incentive for students to organize materials on their own, therefore discouraging students' active involvement (Last, O'Donnell & Kelly, 1998). Also, readers who are strongly goal-oriented were shown to experience more navigational problems with highly structured hypertexts (Last, O'Donnell & Kelly, 1998).

Shapiro (1998) found that the participants using the highly structured hypertext performed more poorly than their counterparts in the unstructured group. The data revealed superior performance of the participants using unstructured hypertext over those using highly structured and linear formats. He speculated that this might be due to the fact that a highly structured system might offer an easier way to get around the system,

thereby depriving readers of a deeper level of thinking. In other words, the less structured hypertext system fosters a deeper level of processing of the information (Shapiro, 1998).

Furthermore, hypertext structures have been studied in comparison with reading manipulations. Reading manipulation is defined as a method of connecting the various passages in hypertext. There are two different types of reading manipulation; scrolling vs. paging. Scrolling allows users to read the text line-by-line through one display window, while paging displays the text in a new screen, showing the text block for block so as to simulate pages in a physical book.

When hypertext structures with different reading manipulations were examined for their ease of learning and user satisfaction in search tasks, a purely hierarchical hypertext with scrolling appeared to be more useful because it seemed to provide clear insight into the structure of the hypertext (Van Nimwegen, Pouw, & Oostendorp, 1999). In fact, adding linearity did not help much to increase usability of hypertext such as efficacy, ease of learning, and user-satisfaction based on performance on 24 search tasks when the reading-manipulation consisted of scrolling as well as paging (Van Nimwegen, Pouw, & Oostendorp, 1999).

The effects of reading manipulation also vary based on readers' previous experience with similar systems. Tombaugh, Lickorish and Wright (1987) found that, for experienced users, paging is more usable than scrolling and that, for inexperienced users, the reverse is true: Pure hierarchical hypertext is better, and scrolling is more usable than paging. On the other hand, Piolat, Roussey and Thunin (1997) found that when comprehension was the goal, paging showed more positive results over scrolling.

McDonald and Stevenson (1996) reported navigational problems with hypertext. The results showed that subjects performed better in terms of browsing and navigation efficiency with the linear text than with the unstructured, nonlinear text while performance on the hierarchical document fell between the two extremes (McDonald & Stevenson, 1996).

When learning materials or systems require high processing and memory storage capacities, such as demanding sequential decisions, cognitive overload followed by disorientation tends to occur. In fact, Wenger (1996) found that hypertext seems to impose more demands for relational processing than does linear text.

Disorientation in Hypertext

Disorientation in reading hypertext is one of the problems that has been cited most frequently (Batra et al., 1993; Conklin; 1998; Dillon & Watson, 1996; Last, O'Donnell & Kelly, 1998; Edwards & Hardman, 1989; Hammond, 1989; 1993; Nielsen, 1990; Smith & Wilson, 1993; Kim & Hirtle, 1995; McDonald & Stevenson, 1996). Conklin (1987) characterized "disorientation" as the difficulty of knowing (1) where you are in the network and (2) how to get to some other place that you know exists in the network.

Disorientation can occur in two ways. First, the reader can become disoriented in terms of hyper-spaces—getting lost, such as not knowing where he or she is or not knowing where to go next (McKnight, 1996; Dillon, 1994; Edwards & Hardman, 1989). The other kind of disorientation is cognitive disorientation—difficulty making coherent understanding of the content and lacking an overview of the material.

Browsing is an exploratory information-seeking activity that involves scanning and tracing ideas from one node to another (McAleese, 1991). The non-directive nature of browsing means that users often may wander through a hypertext without stopping to study or think about the ideas the document presents. Consequently, users may be unable to recognize which nodes they have visited or which parts of the document remain to be seen. In this case, learning may suffer because hypertext readers have fewer mental resources directed toward the learning task because they have to focus on re-orienting themselves within the materials (Tripp & Roby, 1990).

Gray (1990) reported that some users experienced navigation problems such as not remembering what they had and had not read, lacking organizational cues, and being uncertain about where to find the information they needed. Also, McDonald and Stevenson (1996) noted similar findings. They found that the users appeared to be uncomfortable with hypertext and expressed a lack of confidence in their own ability to use it.

An individual learner in a hypertext learning environment has to deal with multiple simultaneous tasks, such as comprehending what they are reading while choosing what they will read next. This places a higher cognitive burden on the learner. Consequently, one can easily lose track of the content and become disoriented. Further, this situation is exacerbated when the learner has to deal with an unfamiliar structure or content.

Therefore, it is useful to find structures that reduce the possibility of getting lost but that still embrace the essential goal of hypertext learning, allowing users some control over how they access information (McDonald, 1998). Text structures should allow

individual learners to work in an active mode by providing a certain degree of control over their learning experience, such as customizing their own learning materials for their own needs (James, 1998).

Other Identified Factors

Unz and Hesse (1999) summarized several identified internal and external factors that influence individuals' learning in hypertext environments. Those are cognitive abilities and styles, such as spatial or verbal skills, and domain knowledge, experience with hypertext, and motivational factors (Unz & Hesse, 1999).

One factor shown to influence human performance in using computers is a spatial ability (Borgman, 1989; Stanney & Salvendy, 1995; Chen & Czerwinski, 1997; Allen, 1999; Chen, 1999; Leidig, 1992), as in one's awareness or mental map of objects surrounding him or her and their relative positions. Stanney and Salvendy (1995) found that individuals with lower spatial memory tend to have difficulties in navigating or completing a task in hypertext environments. The difficulties experienced by low spatial memory individuals were particularly related to navigation through abstract information structures.

Previous experience and domain knowledge also have been shown to influence search performance (Egan, 1988; Nielsen, 1995; Jacobson & Fusani, 1992; Shin, Schallert & Savenye, 1994; Viau & Larivee, 1993). This experience and knowledge generally can be defined in one of two ways: knowledge of the search topic or domain and knowledge of the system used. Jacobson and Fusani (1992) found that system knowledge and computer experience critically influenced search performance in

hypertext systems. In turn, users' ability to navigate hypertext learning systems seem to influence their learning performance.

Grabowski and Curtis (1991) stated several motivational factors which are attention to and interest in the content of information or the technology, perceived relevance of the information, and self-efficacy. Also, gender is considered an internal factor that influences learning and information seeking in hypertext systems. However, the results have been conflicting due to the fact that gender is confounded with other factors such as computer experience (Unz & Hesse, 1999).

In terms of external factors, considering system features is important (Unz & Hesse, 1999). External aids such as graphical maps of content structure or menus and indexes to outlining the different sections of content are used to promote efficient hypertext navigation and learning.

In order to minimize navigational problems, many authors have suggested different navigational aids such as navigation maps or indexes (Astleitner, 1998; Jonassen 1988; Locatis et al., 1989; Shneiderman & Kearsley, 1989; McDonald, 1998). Navigational aids, such as given in the examples above, are a form of advisement to help users keep track of where they are in a hypertext environment and of which sequence they should follow (Shin, Schallert & Savenye, 1994). However, the question of whether different access tools are equally suited for different tasks is not often addressed (Unz & Hesse,1999). For example, providing an index with hyperlinks might help in search tasks but is not necessary for specific learning tasks such as comprehension of a given text.

Furthermore, whether different access tools for different tasks are equally effective for all individuals is another question that should be addressed. For example,

Lai and Lehman (1993) found that explicit menus signaling hierarchical organization of the learning content produced better search performances. On the other hand, the study of Stanton, Taylor and Tweedie (1992) concluded that the use of maps as navigational aids resulted in poorer performance, less use of the system, lower perceived control, and poorer development of cognitive maps.

Cognitive style has been found to be related significantly to the development of cognitive maps (Chou & Lin, 1997) and search performance (Korthauer & Koubek, 1994). The Field-Independent (FI) style is one of more active and analytical learners while the Field-Dependent style is one of more passive and 'socially oriented' learners. Korthauer and Koubek (1994) found that the FI participants' search outcomes were significantly more accurate than those of the FD participants. This notion is known as a different learning style. (More specific details are explained in the section under learning style.)

The relationship between cognitive style and search performance also varies according to users' experience with a system. For example, Palmquist and Kim's (1999) study results indicated that while cognitive style (FD/FI) significantly influenced the search performance of novice searchers, the influence was greatly reduced in those searchers who had online database search experience.

However, Chen and Rada (1996) concluded, based on the meta-analysis of 23 experimental studies, that individual differences in cognition alone do not have significant effects on the use of hypertext. They tried to identify factors that influence hypertext usability, such as user characteristics, task complexity, and browsing strategies with other external aids. They concluded that graphical maps that help users visualize the

organization of hypertext have significant impact on the usefulness of a hypertext system. They also found that task complexity has the greatest effect, followed by graphical maps. They noticed significant discrepancies among existing experimental designs for hypertext usability studies and suggested that hypertext systems seem appropriate for open tasks such as browsing and assimilating (Chen & Rada, 1996)—exploring and piecing together information as it is discovered.

Individual Differences in Hypertext Environments

Due to advances in information technology, interest in the effects of individual differences has been increasing. Research on individual differences is interdisciplinary (Chen, Czerwinski & Macredie, 2000). The topic of individual differences has a diverse range of aspects, including cognitive abilities and style, personality, and other factors such as gender and previous knowledge.

The key to a more effective approach to advancing hypertext learning systems lies in the development of a deeper understanding of multi-dimensional aspects of human and computer interaction. The first step is to understand the benefits and difficulties each individual may encounter when they interact with hypertext structures. This will help us to develop better designs for new learning environments.

Chen et al. (1999) emphasized the importance of maintaining a balance between individuals' abilities and demanding tasks. This is particularly important for instructional purposes. The basic idea is that if performance differences are predictable enough, then it is possible to control them through the design of and training for hypertext systems (Chen, Czerwinski, & Macredie, 2000).

Accommodating individual differences remains a challenge (Chen, Czerwinski, & Macredie, 2000). Effective and flexible ways of tailoring learning materials and systems for individual needs and characteristics ought to be developed along with the technology.

Hypertext learning is influenced by both the characteristics of the learners using it and the structural and interface design of the systems (MacGregor, 1999). Without understanding both ends, the development and utilization of this new technology will be limited. Unz and Hesse (1999) argued that one essential question for investigating hypertext is how learners use the non-linearity of hypertext as a distinctive feature, such as their navigational patterns. Do learners follow all links? Might they follow the same link twice, if it appears in more than once in the same excerpt? Arguably, different text formats themselves also encourage users to follow a certain navigational pattern. In fact, it is essential to identify not only how an individual user navigates the text based on his or her own unique characteristics but also how certain text formats foster certain navigational patterns.

Individual Differences in Navigation

Individuals have shown different navigation patterns in hypertext environments, and these different navigation patterns seem to influence their performance in hypertext learning environments (Britt, Rouet, & Perfetti, 1996; MacGregor, 1999; Last, O'Donnell, & Kelly, 1998; Ford,1999). Students with different cognitive profiles demonstrate different navigational strategies and navigate hypertext systems in different ways. MacGregor (1999) studied the influence of three cognitive attributes (prior knowledge, need for cognition, and a sense of efficacy) on navigation performance. He found differences among students in the paths taken, the type of nodes visited, and the amount of time spent at each node. Three different profiles were identified based on

similar levels of prior knowledge, need for cognition, and self-efficacy: Sequential Studier (SS), Video Viewer (VV), Concept Connector (CC).

The SS style was characterized by sequential access to nodes on the screen, usually from left to right or top to bottom. The SS moved slowly through the nodes and the objects within a node in a sequential manner. It appears that the goal of the SS is to cover the material thoroughly, and this type of user focuses on the textual components of the system (MacGregor, 1999). Since this study was highly qualitative and done with only 10 seventh- and eleventh-grade students, the results should be interpreted carefully. However, Britt, Rouet, and Perfetti (1996) also noticed that some students tended to navigate a presentation passively in the order provided although they were told to select the documents freely with a given time limit. It appears that some individuals might prefer or get used to reading a text in a sequential manner regardless of text format.

The VV style was characterized by a primary interest in the video nodes (MacGregor, 1999). Individuals in this group showed little evidence of cross-linking, integration, and use of resources or the graphic gauges and very little reading of the textual objects. It appears that the goal of the VV is to achieve thrills and stimulation via visual stimuli and they seem motivated by the novelty provided in some of the video clips (MacGregor, 1999).

The CC style of navigation reflected the learners' interest in or need for further explanation or example, integration with prior knowledge, and cross-linking to other related nodes of information (MacGregor, 1999). They did not access the nodes sequentially. They would often access a single node from several linking origins, recognizing connections between the nodes. They seemed to access items selectively.

This style was characterized by a flexible user model, and these students tended to verbalize more often than the students in the other two groups (MacGregor, 1999). It was observed that the CC style users read carefully at times, skimmed at other times, and moved back and forth between text and graphic objects. Britt, Rouet, and Perfetti (1996) also noticed that some students were able to prioritize the documents' importance and study first those documents that they judged most important.

MacGregor (1999) further analyzed the cognitive characteristics of these three types of users. The CCs tended to have more prior knowledge of content whereas the SS and VV had generally moderate levels of prior knowledge. Also, the CCs had higher levels of need for cognition and internal locus of control whereas the SS had lower levels of need for cognition and a lower sense of self-efficacy. Two additional findings were that individuals identified as CCs were all males and that females appeared to have low levels of prior knowledge of the content, which in this case were 'concepts related to science'.

Last, O'Donnell, and Kelly (1998) also noted that readers had different navigation patterns based on their prior knowledge of content. Students with low prior knowledge tended to go through the material systematically in the presented order while students with high prior knowledge tended to jump from point to point, looking to fill in missing fragments of knowledge (Last, O'Donnell & Kelly, 1998). Some students visited nodes in no particular order, including revisiting some nodes after exploring others (Last, O'Donnell & Kelly, 1998).

Ford (1999) also addresses some interesting behavioral patterns of different learning approaches, where he describes as holist and serialist. Those identified as holists

tend to focus on a broad conceptual overview into which they later fit details. In contrast, those identified as serialists tend to focus on local details at early stages and gradually developed an overall picture. While holists like to use concept maps, serialists prefer keyword indices (Ford, 1999).

Domain knowledge, topic knowledge, individual interest and situational interest within the context of a hypertext environment also have been found to influence learning (Lawless, Brown, and Mills, 1998). Lawless et al. found that domain knowledge strongly influenced the amount of information recalled regardless of the medium used to present the text. It appears that individuals with different domain knowledge levels employ different browsing strategies in hypertext (Lawless, Brown, & Mills, 1998; Carmel, Crawford & Chen, 1992). For example, students with higher knowledge selected and pulled together information more efficiently. Low knowledge readers seemed to have difficulty making associations between informational units from the hypertext environment (Lawless et al., 1998).

Prior Knowledge of Content (Domain Knowledge)

The effectiveness of a given hypertext structure depends on an individual's prior knowledge. The disorientation problem is particularly noticed among hypertext readers with low levels of prior knowledge. According to McDonald (1998), the problem seems to be particularly evident when nonlinear texts are used, and hierarchical text appeared to ease the disorientation problem.

Last, O'Donnell, and Kelly (1998) also reported that students with low levels of prior knowledge complained of navigational problems, got lost easily in the system, and were less successful at their tasks due to cognitive overload. Processing nonlinear

hypertext does make more demands for use of relational information (Wenger, 1996). This is particularly troublesome to those with low levels of prior knowledge.

Some studies have shown that students with low levels of prior knowledge performed significantly better when they were given limited access (fewer links) rather than free access (Shin, Schallert, & Savenye, 1994; Marchionini & Shneiderman, 1993). Students with low levels of prior knowledge navigated less efficiently, missing and repeating more topics when they were in the advisement condition (with a human assistant) than when they did not have advisement (Shin, Schallert, & Savenye, 1994). It was suggested that individuals with different levels of prior knowledge seem to require different types of instructional approach (Shin, Schallert, & Savenye, 1994) including different types of information presentation styles.

Khan and Locatis (1998) studied the effects of link-density (number of links per display) and display format (in paragraphs or lists) on search performance. The use of fewer links displayed in list format produced the best results (Khan & Locatis, 1998).

Low link-densities have been found to produce more focused exploration and in turn reduced cognitive load (Shin et al., 1994; Khan & Locatis, 1998). To readers, more choices mean more information to process while interacting with hypertext. This tends to complicate search performance and causes cognitive overload. Therefore, it was suggested that for users with low prior knowledge of a specific knowledge domain, a text with a certain degree of linearity might be more effective.

Hypertext-based learning has been shown to be more successful when cognitive load is reduced. Providing an explicit text structure for users is one way to accomplish this (Chang & Rice, 1993; McDonald, 1998). However, some have argued that ill-

structured learning systems allow learners to browse freely (Chang & Rice, 1993; Lee, 1999) and produced better learning than highly structured systems. For example, students with high prior knowledge profited most from a less structured learning environment (Akanabi & Dwyer , 1989; Astleiter,1998).

Readers with previous experience of browsing searched more efficiently due to their superior task prioritization (Khan & Locatis, 1998). Khan and Locatis (1998) suggested that prior knowledge (previous hypertext browsing experience) helped students to develop a better mental model of the material and its structure based on links. Chen (1999) found that hypertext search experience had a significant effect on participants' recall scores. Experienced hypertext searchers had higher recall scores than less experienced individuals (Chen, 1999).

Learning Style

Each individual develops different strategies to acquire and organize information. Depending on each reader's cognitive learning style, they seem to benefit differently from the nonlinear structure of hypertext (Goldstein & Blackman 1978).

One of the most extensively studied cognitive learning styles is Witkin's field independent/dependent (FI/FD) theory (Brown, 1987). Originally this notion was developed based on individual differences in analytical skill. FI learners tend to be more analytical while FD are more 'socially oriented' (McCorkel & Cohen, 1988). FI learners tend to adapt an active approach toward learning while FDs tend to adopt a passive approach (Goodenough, 1976).

Cognitive Learning Styles in fact do affect hypertext search performance. FIs showed better search performance on hypertext than FDs (Korthauer & Koubetk, 1994; Ellis, Ford, & Wood, 1993, Palmquist & Kim, 1999). It was shown that FIs tend to

explore the hypermedia system in a non-linear manner whereas the FDs navigated in a more linear fashion (Liu & Reed, 1994; Leader & Klein, 1996).

In particular, FD-novices tend to navigate the web in a more passive, linear manner and also get lost more frequently (Palmquist & Kim, 1999). FDs tend to prefer a well-structured set of stimuli and do not seem to like formulating a structure of their own (Palmquist & Kim, 1999). Palmquist et al. speculated that the web's visual complexity and numerous navigational choices might not be as beneficial for FDs.

Lin and Davidson (1996) investigated the different learning strategies used by FI/FD people in hypertext learning environments. They found FD learners tended to use picture and video features that represented the overall view of the content. The FI learners were more likely to use componential features such as an index (Lin & Davidson, 1996). Other studies revealed similar results showing that FI users made better use of indexes and content maps (Khan & Locatis, 1998; Leader & Klien, 1996 ; Chou & Lin, 1997). Lee (1989) found that FI users performed better with hypertext than with linearly organized text.

Lin and Davidson (1996) also investigated the effects of five different hypertext structures on recall and attitude. They found that FIs tended to outperform FDs regardless of structures employed. Furthermore, the participants tended to prefer hierarchical structures to the linear versions. It was also noticed that FIs appeared to be more self-motivated with greater expectations of achievement.

Past studies have explored the effects of different learning strategies in hypertext learning environments by using learning strategies to predict simple cognitive performance. However, not much research has been conducted for addressing the

problems or the benefits of new hypertext systems in terms of their ability to adapt to readers' individual needs and interests.

Text Format Characteristics: Nonlinear text and Cognition

One of the challenges for instructional designers is how best to represent information (Schroeder, 1994). Research on text structure, schema development, learner control, and text enhancement techniques provide a good insight for designing effective instructional materials to improve learning (Schroeder, 1994).

One way to measure the effectiveness of instructional material is by measuring a reader's recall and comprehension of its content. Past studies have compared traditional text versus varying forms of hypertext. In these studies, traditional text most often was defined as text in a linear format that flows from a certain beginning consecutively toward a certain end. In contrast, hypertext most often was defined as text in a nonlinear format in which the reader makes choices as to what sections to read and in what order. This is accomplished by using a computer mouse to click on colored and/or highlighted sections of text that would bring up a related page of hypertext.

Gordon, Gustavel, Moore, & Hankey (1988) found that the linear presentation format resulted in better comprehension of central ideas compared to the hierarchical hypertext presentation. However, Dee-Lucas and Larkin (1992) found some positive outcomes of a structured hypertext format in that the hierarchical hypertext allowed faster selection and resulted in better memory for item location in the table of contents.

Plude (1992) points out that selective attention can be conceived of as executive control in the memory system. In other words, selective attention determines which

information is processed or ignored. Selection is one of the necessary conditions for memory retrieval.

Most studies of text information processing have been done with traditional linear text, such as books, but more recent studies address the acquisition of knowledge in terms of nonlinear formats such as hypertext. It was suggested that nonlinear text provides a high degree of interactivity and promotes active learning. Interactive learning is widely assumed to be effective because active learning produces more effective learning outcomes. A basic assumption is that hypertext facilitates active learning. In other words, an individual's active participation in information seeking is an important aspect for the hypertext learning condition.

When readers read a text, they are required to build a mental representation of the content in their own minds. Traditional linear text presents a continuous linear flow of information. With traditional text, readers read from top to bottom so that text processing is continuous. However, nonlinear text interrupts continuous text processing because readers move back and forth between the text units. Dee-Lucas and Larkin (1995) speculate two possible effects of this discontinuity. First, "interruptions in text study could interfere with the development of an integrated representation of the text as a whole (p. 435)." Each time readers select a new piece of information, they have to build a connection and incorporate the prior information; thus, it would be difficult for readers to identify the main idea of an overall text. Second, "interrupted text study may increase the depth of processing of content within each unit by focusing attention on the individual unit (p. 435)." This suggests that hypertext's nonlinearity might foster developing

improved (although somewhat fragmented) knowledge of certain sub-topics within a subject.

According to Bourne (1990), as a learner constructs a path to read the material, he/she makes choices and becomes a more active learner. This active role in acquiring knowledge allows the learner to reconfigure his/her own educational materials.

To remember factual information successfully, retrieval must be in response to some sort of cue (Farr, 1987). Dee-Lucas and Larkin (1995) suggested that unit titles would be better recalled than corresponding headings and subheadings from traditional text. They assumed that the way in which the text is partitioned into units is highly salient to the reader because this information guides him/her to the next choice. In fact, they found some positive effects of the hypertext units. For example, the hierarchical hypertext they used allowed faster selection and resulted in better memory for item location in the table of contents. However, they later found that the effects of different presentation formats can be different in terms of different reading tasks, such asking readers to summarize what was read versus just reading for interest.

On the other hand, Jonessen and Wang (1990) argued that nonlinear text may actually hinder factual recall. Many scholars have suggested that hypertext systems can disorient to learners and increase the cognitive burden of remembering the links as well as comprehending information as a whole. (Heller, 1990; Jonessen & Wang; Spiro & Jehng, 1990; Schroeder, 1994; Dias, Gomes, & Correia, 1999; Lee,1998; Lee, Ferguson, & Tedder, 1999). It was found that participants who read a traditional linear text produced higher recall scores than those reading networked hypertext (Lee, 1998; Lee, et. al, 1999). Phillips and his colleagues (1992) examined different types of navigational

devices in a hypertext database and found that those provided with the most minimal navigational tools achieved the highest recall.

System structure was also relevant to the ways in which learners approached the materials, as navigation behavior was affected. The less structured system seems to have promoted more active processing and a deeper level of learning (Shapiro, 1998).

However, the use of hypertext does not always foster better comprehension or learning (Rouet, 1992). In some studies, readers actually found hypertext more difficult to read than linear text (Rouet & Levonen, 1996). According to Dias and Sousa (1997), people often get confused and even lost in hypertext environments with which they're unfamiliar. Even simple hypertexts can be confusing for inexperienced readers (Rouet, 1990).

Researchers have shown that prior knowledge or existing schemata influence learning. For example, Schroeder (1994) suggested that users may have difficulty tracking the overall structure of information in a hypertext document and relating it to their prior knowledge of the content. This problem may be worse for students with low prior knowledge by causing disorientation or cognitive overload. In his study, those with high prior knowledge did better on most variables and showed a greater increase in structural knowledge than those with low prior knowledge. One interesting finding is that treatments that provide more structural knowledge support appear to be less influenced by the degree of prior knowledge. This study suggests that further research is required to clarify how to help readers with low prior knowledge to get familiar with using hypertext.

Schroeder (1994) pointed out that hypertext requires skills of navigating and suggested that hypertext is not suited for highly structured learning tasks. Hypertext readers must integrate specific content into the text as a whole. Dee-Lucas and Larkin (1995) argued that readers may process the text units as segment information rather than as interrelated information. Thus, readers of hypertext might have difficulty identifying the main points from the text as a whole, compared with readers using traditional text.

Maintaining coherence among information is a potential problem in using hypertext, and some solutions have been proposed. Dee-Lucas and Larkin's study (1995) suggests minimally structured overviews that allow readers to construct their own organization of the information. In fact, McNamara, Kintsch, Songer, and Kintsch (1996) found that minimally overviewed formats were beneficial for high-knowledge readers. They speculated that minimally coherent formats forced readers to engage themselves more actively in processing information read. However, Kalyuga (1998) found the same effect and proposed a different reason. He argued that minimally overviewed formats for high-knowledge learners are advantageous because they reduce the cognitive load caused by the need to process redundant information.

Some studies have investigated the influence of different hypertext structures on participants' time spent viewing of text (McKnight, 1990) and the accuracy of the responses (Edwards & Hardman, 1989; Leventhal, Teasley, Instone, Rohlman, & Farbal, 1993; McKnight, 1990; Rada & Murphy, 1992). It was found that hypertext readers are generally slower and less accurate at answering questions compared to those who have read a linear text.

Hypertext is normally integrated with other visual or auditory aids to produce better quality learning. Because hypertext is often used in combination with other media such as video, audio, and graphics, it is hard to consider these systems as forms of purely electronic text, applied in practice. However, the way hypertext systems affect an individual's cognitive information processing should be studied on a micro level.

Studies tend to suggest that characteristics of both the hypertext and the reader can render one form of hypertext superior to another. Individual readers' relevant experience, previous knowledge of topics, and motivational factors are the important influences on recall and comprehension in information processing. However, how these influences actually work in the memory process is unclear. Text comprehension and recall is a multi-layered cognitive activity that occurs in the context of a limited-capacity working memory (Rouet & Levonen, 1996).

Limited Cognitive Capacity: Working Memory and Information Processing

Even though cognitive abilities have been found to be one of the single most influential sources of individual learning differences in hypertext learning (Chen, Czerwinski, & Macredie, 2000), not much research has been done regarding individual differences in limited cognitive capacity. One essential concept in the information-processing literature is working memory, a system responsible for the temporary storage and processing of information (Baddeley, 1986). Working memory is conceptualized particularly in a way that puts more emphasis on the processing functions of the central executive (a subsystem of working memory that controls the selection and organization of information) (Wenger, 1996). Working memory plays a critical role in integrating information during recall and comprehension. Several models show a dual role of

working memory: First, it grasps recent information from a reading and connects it to related information in long-term memory. Second, it temporarily maintains this main information for constructing an overall understanding of the passage (Kintsch & Van Dijk, 1978; Baddely, 1986; Lee-Sammons & Whitney, 1991).

Individuals have different capacities for working memory, some higher and some lower. Some researchers have suggested that individual differences in working memory capacity predict readers' level of text integration ability. For example, Yuill, Oakhill, and Parkin's study (1989) showed that readers with low working memory span have poorer text integration abilities than readers with high working memory span. Readers with low working memory capacity show poorer comprehension of texts than readers with high working memory capacity because they seem less able to maintain necessary information in an active state (Lee-Sammons & Whitney, 1991). On the other hand, some data suggest that high-span readers are better able to maintain multiple tentative interpretations and use text elements to test those interpretations (Baddeley, Logie, Nimmo-Smith, & Brereton, 1985; Lee-Sammons & Whitney, 1991).

Lee-Sammons and Whitney (1991) examined the effect of working memory span and readers' perspectives on comprehension of a narrative linear text. In their study, subjects were told to read the story from different perspectives (e.g. either from the perspective of a potential home buyer or a potential burglar) and to think about the relevance of each sentence from that perspective. One interesting finding is that subjects recalled more information relevant to the new perspective than information relevant to the original encoding perspective. For low and medium-span readers, shifting perspectives resulted in less recall of new information than if the perspective was held

constant while high-span readers recalled information independent from shifting perspective. Furthermore, low-span readers were poor at recalling information not relevant to the original encoding perspective while high-span readers recalled similar amounts of perspective-relevant and irrelevant information.

Most studies for measuring memory span have been done with a test of storage capacities for unfamiliar and unrelated information. However, these kinds of tests didn't seem to indicate the capacity of working memory available particularly during reading. Daneman and Carpenter (1980) designed a task to measure the capacity of working memory during reading. They presented subjects with a series of unrelated sentences that they needed to comprehend to answer test questions that followed. At the end of the presentation, subjects were asked to recall as many of the last words of the sentences as possible. The number of words a subject correctly recalled became the subjects' reading span. They found that the subjects' active efforts to encode associations between the last words of the sentences resulted in better recall.

According to Ericsson and Kintsch (1995), "to perform any cognitive tasks, an individual must maintain access to large amounts of information, needs contextual information to integrate information in the current sentence coherently with information in the text previously read, and maintain the results of intermediate steps in memory" (p. 211).

According to Baddeley (1986), the working memory capacity is not only important in selecting learning strategies, but also in maintaining and operating strategies for retrieval from long-term memory. By using concurrent memory load, he was able to

explain a limited capacity memory system that influences learning, comprehension, and reasoning.

A well-designed computer text requires less working memory when presented appropriately for that purpose (Schroeder, 1994; Budd, Whitney, & Turley, 1995; Dee-Lucas & Larkin, 1995; Lorch & Lorch; 1996). Unfortunately, few computer materials have been designed in consideration of this.

Working Memory Capacity and Text Format

In most theories of cognitive tasks, it is agreed that construction of referential representation in memory for the interpretation of the text is necessary. The 'structural hypothesis' has been developed and tested using different types of representations (e.g. different text formats) and cognitive processes (e.g. recall or comprehension) (Nakamura, Kleiber, & Kim, 1992). The structural hypothesis suggests that recall depends on the memory strength (e.g. high and low) of the interconnections and the number of types of interconnections (e.g. vertical and horizontal) within a representation. Readers who use a structural strategy to understand a text recall more top-level information than do readers who process text in a linear manner.

According to Budd, Whitney, and Turley (1995), in order to establish relations between closed clauses or sentences, readers have to maintain the information most recently processed from the text in working memory. Thus, working memory facilitates the comprehension of text by building coherence at a local and general level. In this aspect, if texts are coherent at a more general or thematic level, readers will require less working memory capacity to process new information.

Individual differences in working memory capacity seem to be related to differences in what kind of information or how much information is retained when one is reading texts (Baddeley, 1986; Budd, Whitney, & Turley, 1995, & Lee-Sammon & Whitney, 1995). Reading is much easier if there is a clear concept stated at the beginning of the passage because readers need only adopt and test it against the remainder of the passage. Otherwise, readers have to construct one while they are reading. Furthermore, readers are required to modify it when they confront new information inconsistent with their initial interpretation (Kieras, 1981). These activities require more working memory to process information.

Budd, Whitney, and Turley (1995) investigated whether individuals' different working memory capacity is related to different working memory management strategies in reading an expository text. One interesting finding was that readers consider information displayed first as more important than information displayed later. In sum, when materials were easy, the performance differences of readers with different working memory spans were small or insignificant. However, these differences got larger when materials were difficult to understand. Lower span subjects performed more poorly on a detailed question in the topic-absent (where there is no heading) condition. These data imply that certain text or passage formats can deter or help readers' recall of more detailed information from a text.

The structure of computer-mediated content can encourage learners' use of cognitive and motivational processes (Viau & Larivee, 1993). Hence designing effective learning materials to match individual readers' cognitive characteristics is important for effective learning. A basic notion of tailored information is to create hypertext learning

systems that provide interfaces tailored to specific learners to accommodate their needs and characteristics.

Sensation-Seeking Tendency

One behavioral characteristic of readers that may impact how they process information in different hypertext learning environments is their sensation-seeking tendencies. Being predisposed to sensation-seeking was a concept largely researched by Marvin Zuckerman. A basic assumption regarding different sensation-seeking tendencies is that individuals have different degrees of predisposition toward sense-arousing stimuli (Zuckerman, Kolin, Price, & Zoob, 1964).

Sensation-seeking is defined as a trait characterized by the need for "varied, novel, and complex sensations and experience and the willingness to take physical and social risks for the sake of such experience" (Zuckerman, 1979, p. 10). Scholars have suggested that these different levels of preferences stem largely from biological mechanisms (Zuckerman, 1988; Gabel, 1994; Frick, 1995). Zuckerman has suggested that "sensation-seeking is a human trait that has evolved as a function of the adaptive value for survival and reproductive fitness" (Zuckerman, 1990, p.314). However, he also speculates that at least a third of the variation in the trait is not inherited.

Zuckerman (1971) laid out four factors found in the validation studies of the Sensation-seeking Scale: Thrill and Adventure Seeking (TAS) and Experience Seeking (ES), in addition to Disinhibition (DIS) and Boredom Susceptibility (BS). Zuckerman postulated that TAS is the desire to engage in physical activities for unusual sensation. ES refers to the desire to seek new experience through an unconventional life-style and travel. DIS is related to the seeking of sensation through other people or partying, social

drinking, and sex. BS is a tendency to avoid unchanging (boring) environments or persons. Drinking, smoking, and using other illicit drugs have been shown to have strong correlations with these factors (Kraft & Rise, 1994).

According to Zuckerman (1990), the high sensation seeker is an information seeker who tends to react strongly to novel stimuli. High sensation seekers tend to have high thresholds for pain and intense stimulation (Zuckerman, 1979). They tend to prefer visual complexity (Zuckerman, Bone, Neary, Mangelsdorff, & Brustman, 1972) and spend more time listening to rock music, attending movies (X-rated movies, in many cases), and reading fictional novels (Ferguson, Valenti, & Melwani, 1991). Effective communication with high sensation seekers must take these characteristics into account.

Recent Sensation-Seeking Classifications

Ferguson, Valenti, and Melwani (1991) defined a sensation-seeking predisposition as "a tendency to engage in behaviors that an individual understands have some likelihood of resulting in a punishment or in the loss of a reward" (p. 196). Three types of sensation-seeking tendencies, also know as risk-taking tendencies, were postulated: rebelliousness, impulsiveness, and adventurousness.

Impulsiveness represents self-reports of behaving without thought and getting "carried away." Adventurousness represents self-reports of enjoyment of risk and new and exciting experiences while rebelliousness represents self-reports of enjoyment of wild parties, drinking, sex, and drug use (Ferguson, Valenti, & Melwani, 1991).

Rebelliousness

In previous research (Ferguson, Valenti, & Melwani, 1991), rebellious personality types were shown to be largely young, single, and male. Rebellious sensation-seeking is associated with high radio use and reliance on radio, but a low reliance on all media for

health information. Smokers and ex-smokers tend to score high in this area (Jex & Lombard, 1998; Lipkus, Barefoot, Williams, & Siegler, 1994). Rebels were shown not to be particularly religious. Rebellious personality types also have been shown to take risks not for perceived benefits but rather for notoriety among others for being rebellious or daring. Rebellious adolescents also tend to respond to the sensational aspects of a message rather than its perceived risks (Moore, 1996; Donohew, Lorch, & Palmgreen, 1998).

Impulsiveness

Impulsiveness is associated with a dislike of thinking. Those predisposed to impulsive sensation-seeking score low on cognitive involvement with health, have negative feelings about health, do not feel in control of their health, and have little concern about their health. Impulsiveness is a construct associated with many types of risk-takers (Eysenck & Eysenck, 1977). Impulsive risk-takers tend to be young, single females and tend to be smokers (Ferguson, Valenti, & Melwani, 1991).

Adventurousness

Adventurousness can be defined as "the desire to try new, exciting activities" (Moore & Rosenthal, 1993, p. 98). Although highly correlated with rebelliousness, adventurousness contrasts with rebelliousness in that it is carefully calculated sensation-seeking. This is a sensation-seeking predisposition that correlates positively with good attitudes about health, a feeling of control over one's health, and strong health values. It would follow that adventurous types would be less likely to engage in binge drinking than those classified as impulsive. Ferguson, Valenti, & Melwani (1991) also describe adventurous types as "those who are young, single, male, or who never or only occasionally attend church" (p. 218). Additionally, both of the above studies found

driving fast was associated with these two types of sensation-seeking (adventurousness and rebelliousness).

Theory of Information Processing and Sensation-seeking

Many scholars have suggested that an individual's information processing depends upon two factors: needs for novelty and sensation (Bardo, Donohew, & Harrington, 1996; Zuckerman, 1994) and further cognitive needs (Cacioppo & Petty, 1982; Cacioppo, Petty, Feinstein, & Jarvies, 1996). In particular, needs for novelty and sensation seem to affect the initial process that leads to further information processing. Zuckerman, Persky, Hopkins, Murtaugh, Basu, and Schilling (1966) have suggested that risk-takers may exhibit a higher need for arousal than non-risk-takers.

Donohew, Palmgreen, and Duncan (1980) postulated an activation model of exposure to information. This reflects how an individual chooses certain information to process based on their cognitive and activation needs. A basic assumption is that individuals have different levels of arousal needs at which they are most comfortable. Attention depends on an individual's need for stimulation by an information source (Zillmann & Bryant, 1985). Therefore, if information does not produce an individual's desired level of arousal, he or she tends to discontinue further information processing (Donohew, Lorch, & Palmgreen, 1998). Therefore, for high sensation seekers, messages should be novel and sensational to be effective.

Donohew et al. (1998) suggested that messages high in sensation value should be more attractive to high sensation seekers. Basically, it was suggested that the effectiveness of messages depends on target audiences' characteristics, such as whether they are high sensation seekers.

According to the laboratory experiments of Donohew et al. (1991) and Palmgreen et al. (1991), high sensation seekers (HSS) responded more positively to messages with high levels of suspense and tension than did low sensation seekers (LSS). Also, HSSs tended to pay more attention to "high sensation value programming" than to "low sensation value programming." Therefore, the sensation value of information is an important determinant of a message effect, particularly for HSSs, even though the results indicate that many LSSs are also affected by the same messages as much as HSSs. Certainly, this shows evidence that based on the characteristics of target audiences such as sensation-seeking tendencies, a message can produce many different results.

Gender and Hypertext

Gender has been shown as a factor that influences students' computer anxiety, experience and self-efficacy (Busch, 1995; Carlson & Grabowski, 1992; Chen, 1999; Igbaria, Pavri, & Huff, 1989; Loyd & Gressard, 1984; Marakas, Yi, & Johnson , 1998; Wilder et al, 1985; Hester, 1998) and further performance (Fetler, 1985) regarding computer-related tasks. It was found that more experienced male users tend to exhibit greater computer efficacy compared to female counterparts.

According to Rosell and Gardner's 1999 path analysis, gender and computer experience were found to be predictive of computer attitudes, which were in turn related to computer efficacy, task-specific performance expectations, and post-performance anxiety. They found that females tend to express more negative attitudes toward computers than males. Furthermore, actual computer usage appeared to create greater anxiety among women than men (Rosell & Gardner, 1999). This gender difference in negative attitude toward computers and computer anxiety has been cited elsewhere

(Collis, 1985; Hemby, 1998; Whitley, 1997). It is unclear as to what causes these gender differences. Furthermore, how these gender differences in attitude toward computers and computer anxiety effect learning in hypertext learning systems.

Gender, however, might be viewed beyond the biological definition. Gender constancy pertains a mental schema that is generally held to be socialized, not biological. According to Marcus, Cooper, and Sweller (1996), a schema is a cognitive construct that permits one to treat multiple elements of information as a single element categorized according to the manner in which it will be used (Marcus, Cooper, & Sweller, 1996, p. 49).

When a story is processed from a particular perspective, the perspective functions as an organizing schema that serves as a framework to integrate information (Baillet & Keenan, 1986). Several studies have shown better recall of schema-related information than schema-unrelated information (Goodman, 1980; Lee-Sammoons & Whitney, 1991; Nakamura, 1994).

Memory retrieval, the cognitive process through which information is migrated from storage to become active, can potentially be influenced by individuals' attitudes (Herrman & Searleman, 1992). Recent surveys of computer skills have revealed gender differences in attitudes toward and achievement in computers and computer use. One hypothesis relating these gender differences is focused on attitudes toward computer use. For example, according to Newman, Cooper, and Ruble (1995), cognitive identities such as gender constancy direct gender role development by encouraging the tendency for a consistent gender identity. Gender constancy is defined as "understanding that one's gender is permanent" in their study (Newman, Cooper, & Ruble, p.328). Once children

consider themselves boys or girls, they start to acquire gender schemata (Martin & Halverson, 1981). Gender schemata are "knowledge structures that categorize objects, behaviors, traits, roles, and attitudes as 'male' or 'female'" (Newman, Cooper & Ruble, p.328). According to this theory, as children get older, these schemata become more elaborate. These gender schemata affect the recall and comprehension of gender-related information (Newman, Cooper & Ruble, 1995).

Based on this concept, Newman, Cooper and Ruble (1995) predicted that attitudes toward computer use (a stereotypically male activity) would be less positive for 5- to 9-year old gender-constant girls. The results were consistent with their hypothesis. For example, gender-constant girls with high levels of gender knowledge liked working with computers less than any other subgroups.

Generally, researchers have found that females like computers less than men. Investigators suggest that less opportunity to interact with computers may be one reason why females show lower levels of achievement than males. Fetler (1985) suggested that lesser amounts of experience might account for the generally lower levels of achievement attained by girls.

The development of negative attitudes toward computers among girls can lead to less experience with computers, and this serves to maintain their negative attitudes. One speculation is that most children start to have computer experience by learning a computer game, but most computer programs and video games have generally been "male-oriented" or masculinized (Brosnan, 1998; p. 40). Therefore, girls may become less interested in computer programs or video games. One survey demonstrated that males and females consider computers and video games more as male activities (Wilder,

Mackie & Cooper, 1985). In a more recent study, 64 percent of female participants agreed that computing was a male activity and that men were better at computing than women (Brosnan, 1998).

According to Wilder, Mackie and Cooper (1985), females in their surveys felt far less confident in dealing with computers than did males even though their experience was not much different. For example, females with more experience with the computer actually reported themselves to be less comfortable and no more skilled than inexperienced males.

Anxiety also had a significant impact on computer use and learning (Compeau & Higgins, 1995). Females tend to report higher levels of computer anxiety than males (Brosnan, 1998; Brosnan & Davison, 1994; Maurer, 1994; Whitely, 1996; Rosell & Gardner, 1999).

Furthermore, the level of computer anxiety is shown to differ based on gender and gender identities. Participants with the high degree of masculinity are less computer anxious (Brosnan & Davison, 1996; Colley, Gale, Harris, 1994). Brosnan (1998) further found that computer anxiety negatively correlated with masculinity for females while femininity positively correlated with computer anxiety for males (Brosnan, 1998). In other words, males higher in femininity were more computer anxious while females higher in masculinity were significantly lower in computer anxiety. This negative correlation between computer anxiety and masculinity for females is consistent with other literature (Charlton,1999).

Gender and psychological masculinity and femininity are shown to be related to computer comfort (the inverse notion of anxiety), engagement, and over-use (Charlton,

1999). One study showed both greater masculinity and femininity to be related to greater computer comfort. It also showed greater masculinity to be related to greater engagement and greater femininity to be associated with less over-use (Charlton, 1999). When variables on computing experience were controlled, sex differences in masculinity were shown to explain sex differences on all three dependent variables. This is also consistent with other findings (Brosnan, & Davidson, 1996). For females, positive relationships were discovered between masculinity as well as computer comfort and engagement (Charlton, 1999; Colley et al, 1996; Bronsnan & Davidson, 1996). Lee (1998) found similar results; females with higher masculine characteristics tended to own a computer and/or have access to a computer.

Recent studies continue to reveal that female college students report higher levels of computer anxiety than do male students (Brosnan, 1998; Charlton, 1999). They also perceive computing as a primarily male activity (Brosnan, 1998). However, in college, highly motivated females consider computers less as predominantly male-oriented. Regardless, there are differences between the sexes in terms of self-reported comfort, skill and overall experience with the computer (Whilder, Mackie, & Cooper, 1985). Temple and Lips (1989) reported that female subjects felt inhibited from pursuing formal study of computers because of uncertainty about their own abilities.

Boys in elementary level education have been found to hold more positive attitudes about computers than girls (Todman & Dick, 1993). Some scholars assume that these tendencies occur because girls have less preference for mathematics and science and believe that computers require the knowledge of math or science for appropriate usage.

Research has shown that boys are more likely to enroll in computer camps than girls. Also, boys tend to spend more time using computers when computers are introduced into the classroom. For example, a California Department of Education (1982) study found that sixth-grade boys were more likely to use a computer at home and at school than girls (Fetler,1985). Fetler's study shows that boys outperformed girls in every major area of computer literacy and computer science achievement.

Despite these findings, some recent research involving college students finds less evidence of gender differences in attitudes toward computer use (Chrisler & White, 1990; Pope-Davis & Twing, 1991). For instance, in one study, 420 college students were surveyed about their computer attitudes after subjects were exposed to computers in either a 'structured' or 'unstructured' condition (Arch & Cummins, 1989). "In the 'structured' condition, students received training in computer use during class time and were required to complete all papers using the computer. On the other hand, students in the 'unstructured' condition were not given classroom-based training, but did have access to the machines outside of class and to training sessions, as well as assistance from experienced students or computer center staff "(1989, p. 245). Three hundred sixty two subjects out of 420 completed questionnaires; 178 in the structured classes and 184 in the unstructured. For females, prior computer use most strongly influenced the three subsequent dependent measures (computer use, attitude toward computers and perceived efficacy) while for males prior attitude was the most influential determinant. Generally, the higher rate of male computer use was decreased in the structured condition and increased in the unstructured condition (Arch & Cummins, 1991). In situations where computer access was structured into classroom activities, the differences between the

sexes were weakened or disappeared (Arch & Cummins, 1991). Under this condition, both sexes were equally able to learn computer skills and to be confident in their abilities to use computers.

There also appeared to be gender differences in terms of computer classes. Females tended to take more introductory courses while males were more likely to take a programming language course (Wilder, Mackie, & Cooper, 1985). No significant gender difference in previous experience with computers was shown in this study.

According to Bamossy & Jansen's 1994 study, although both genders had at least one experience working on a computer, boys were much higher in self-reported number of hours on the keyboard. On the spatial abilities test, boys scored 10% higher than girls (Bamossy & Jansen, 1994). In terms of attitude, girls had significantly higher scores on fear (Carey, Dusek, & Spector, 1998) and negative affects compared to boys. Boys got much higher scores on measures of self-efficacy, positive affects, and positive attitudes regarding the use of computers.

Self-efficacy is an important construct in designing effective hypertext learning systems (Bandura, 1971; Compeau & Higgins, 1995). Self-efficacy is defined as the belief that one has the capability to perform a particular task. Compeau and Higgins (1995) found that individuals with low self-efficacy are more aware of the existence of support within their learning systems than those with high self-efficacy because they tend to use those systems more often. On the other hand, individuals with high self-efficacy tend to enjoy using computers and consequently seem to experience less computer anxiety (Compeau & Higgins, 1995).

These different approaches to learning how to operate and interact with computers may be subject to differential responses based on gender. Many studies have revealed different abilities in terms of gender. For example, according to a survey by Swann (1992) called the Assessment of Performance Unit (APU) survey, girls tend to do better than boys on reading and writing tasks. Born and his colleagues and Stumpf and Jackson found evidence for male superiority in reasoning and a female superiority on perceptual speed and memory (Born, Bleichrodt & Flier, 1987; Stumpf & Jackson, 1994).

Gender differences were also found in more practical applications. For example, researchers in one study found that females found it easier than did males to browse in search of articles on the Internet (Schierhorn, Wearden, Schiderhorn, Tabar, Andrews , 1998).

Also, Hester (1998) found that computer anxiety and gender were mediating factors in the evaluation of the interactive sample test and the course web site. In his study, males tended to prefer the more interactive version of the test as the more valuable learning tool (Hester, 1998).

Furthermore, Michael (1995) investigated the non-linear nature of hypertext learning environments with elementary school students. He found a gender effect on attitudes toward lesson organization. According to Eveland and Unwoody's 1999 study based on the 'thinking aloud method,' girls tend to express disorientation in hypertext structures more than men. On the other hand, boys found the lesson more clearly organized and easier to follow than did females, regardless of the text format (Michael, 1995).

It was also found that the recall scores of female students varied less based on the different hypertext formats than did male students (Lee, 1998; Lee et.al, 1999). According to Lee's 1999 experiment, male students who read the unstructured (networked) hypertext had much higher recall scores than those reading identical information from structured hypertext documents. However, there was little difference among female students.

The studies reported here offer a good foundation to support the general findings in the literature regarding gender differences with respect to high-technology products like computers. Based on past studies of gender differences regarding computers, it is logical to examine differential responses by gender to new communication technologies, such as hypertext.

Calling for a New Conceptual Framework; Individual Differences

When a new technology is introduced and used prevalently in a society, the society undergoes changes. These changes exist in our practical life as well as in the conceptual frames that help us to understand who we are and what kind of a society we live in. Understanding how the nature of a new technology interacts with existing ones and how the technology will be used in the future is important for further development to maximize the potential benefits of the technology.

Among the many questions that need to be addressed is how best to make use of hypertext potentials (Vargo, Shierhorn, Wearden, Schierhorn, Endress Tabar, 1997). If the goal is to identify effective uses of hypertext in instruction, learner characteristics that influence the success of individuals' learning need to be further analyzed. How to

develop effective learning materials depends on each individual's characteristics that interact with learning contents, formats, and systems (Lee, 1999).

Previously identified characteristics of hypertext should be noted for further development of this technology. While the flexibility of hypertext with easy and direct access to other information should be carefully considered in many applicable situations, the potential problems of hypertext such as disorientation should be redirected in a way that minimizes disadvantages and turns to the effective uses of the technology. In this aspect, a hybrid form of two text formats, expanding hypertext, might suggest a new direction for further development of this technology. For example, a mixed text eliminated the disorientation problems of novices during browsing, and this suggests that an appropriate text structure might compensate for a user's lack of a conceptual structure of the domain (McDonald, 1998).

How to structure information is one of the major issues that needs to be addressed. It was suggested that different types of content segmentation and linking structure should be considered based on types of learning goals with hypertext (Dee-Lucas, 1996). However, one of the problems of developing effective hypertext learning materials is that the majority of these user interfaces are designed with only a generic, ideal reader in mind (Cehn, Czerwinski, & Macredie, 2000).

Individuals learn differently. Therefore there is no one optimal ordering of information nor any optimal level of detail. It all depends on who reads, how, and for what purpose (Rouet, Levonen, Dillon, & Spiro,1996).

Hypertext allows us to individualize instruction based on each reader's style and capacity. It is not just a technology that stores, manipulates, and presents information, as

Dillon (1996) postulated. It allows us to open a new chapter of effective communication and learning. This capability of tailoring or accommodating information in hypertext environments allows educators and instructional designers to make design decisions for effective learning materials based on the needs of users rather than on fuzzy principles or mere intuition (Dillon, Richardso, & McKnight, 1989).

Egan and Gomez (1985) suggested a three-stage approach to accommodate individual differences: isolation, assaying, and accommodation. The first stage, isolation, aims to identify individual reader differences that significantly influence performance of a learning task. The second stage, assaying, decomposes a task so that one can identify the key task components that explain variability in performance. In the accommodation stage, the components of the key task identified in the second stage are either modified or eliminated in order to simplify the overall task for the reader (Egan & Gomez,1985). A compensatory match of individual reader abilities is presented as one example. If it is possible to design learning materials in manners that enhance learning by accommodating different styles and capacities of learning, then each reader can optimize his or her own learning experience.

Hypertext does and will continue to influence how information is conveyed and utilized (Dillon, 1996). Individual reader differences should no longer be considered as restrictions or barriers for designing an effective learning system. An ideal hypertext learning system should not only compensate individuals for their own shortcomings, but also continually reinforce their merits to enrich the course of learning.

Proposed Alternative Hypertext: Expanding Hypertext

Unlike the most common format of hypertext in use today, which shows the additional text of each hyperlink on a separate page (paged hypertext), expanding

hypertext is defined as an electronic text that shows the additional excerpts or documents inserted into the same page as the hyperlink itself.

In this study, expanding hypertext is proposed and further examined. Expanding hypertext is a proposed hybrid computer text format in which the reader can have additional details of information inserted at designated points when he or she clicks a link. It maintains the linear presentation of information at the same time allowing hypertext's flexibility to inter-link related information. In this way, readers can explore their learning materials based on their needs and preferences while better facilitating their cognitive processes, such as recall and comprehension, by not interrupting them due to the non-linearity of hypertext learning materials.

To envision this, imagine seeing your text as a synopsis with, perhaps, only one sentence covering each major point. But each excerpt contains "expanding hyper-links" that, when clicked, expand and elaborate on the point. Under that elaboration, further hyper-links may exist. After clicking on everything the reader finds of use or interest, the text has been molded into content crafted specifically for his/her own informational needs and interests. This means the reader's attention is not lost reading unneeded or undesired elaborations in order to get to the point, and it greatly increases the richness of content that is useful to the reader at what ever his or her current state of understanding of the topic is.

Conversely, paged hypertext is very effective for reference documentation but is considerably less effective for academic texts or tutorials than is simply one long page of text (or one long series of pages, chronologically ordered, that we call "linear text"). As commonly found on Internet web pages, clicking on a paged hyperlink results in the

referenced text being displayed in a manner consuming the whole window where the referencing document previously existed. Hence all further and previous text and links on the referencing document are no longer visible.

The notion of expanding hypertext was first explored by Douglas Engelbart (1972), although it was not known by the same name and never gained popularity.

In particular, this notion of expanding hypertext is useful for academic texts and tutorials. Different people learn better in different ways. Learning is a very individual experience based on individual cognitive capacities, previous experiences, personal characteristics, and external environments. Therefore, effective learning materials should be designed in a way that fits to these conditions. In this study, expanding hypertext will be tested for its effects on participants' recall and comprehension in comparison with other types of hypertext.

This study mainly applies two theoretical constructs--the notions of limited-capacity working memory and sensation-seeking tendencies--to examine individuals' encoding, comprehension and retrieval of information in hypertext learning environments.

In sum, effective learning should be based on careful analysis of individuals' needs and characteristics such as internal factors (cognitive capacities, motivational factors, predisposition) and external factors such as text formats and contents of messages. In this study, the relationship among individual characteristics (sensation-seeking, need for cognition, uncertainty orientation, need for orientation, gender, and gender characteristics) and proposed text structure (traditional, networked, and expanding hypertext) are examined based on the working memory capacities of individuals

(Figure 1).

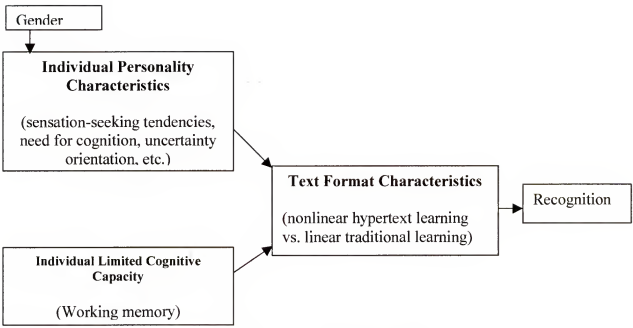

Figure 1. Proposed model of effective computer-mediated learning

Research Questions

RQ1 - How do the different computer text formats influence the subjects' learning?

Basically, it was assumed that students who read texts in a scrolling text format or an expanding hypertext format would exhibit less disorientation and therefore better learning than those who read the same information in the paged hypertext format. It is presumed that the nonlinear nature of paged hypertext creates a cognitive burden on learners.

RQ2 - How does individual working memory capacity affect the subjects' learning?

If the nonlinear presentation of information creates a cognitive burden, disorientation should be greater among students who have lower working memory capacity, which in turn affects their learning performance.

RQ3 - How do individual sensation-seeking tendencies influence readers' learning?

This question is driven by the fact that high sensation seekers tend to react to high sensation values in various modes of information. This means that people with individual personality or cognitive traits such as sensation-seeking tendencies should exhibit different types of reactions to incoming stimulus. Therefore, it was assumed that high-risk takers (adventurousness) or those who were high in other types of cognitive or personality traits such as need for cognition and uncertainty orientation would perceive and react to different types of hypertext differently. If significant differences were found based on their different characteristics, then which text formats are better or worse for what types of individuals to optimize that individual's learning experience?

Research Hypotheses

In this study, four dependent variables (liking of presentation style, disorientation, comfort with presentation style, and recognition scores as a function of learning) were examined based on various factors previously discussed in earlier sections (working memory capacity, sensation-seeking tendency, need for cognition, uncertainty orientation, computer use and efficacy, hypertext familiarity and knowledge, familiarity with content, interest in content, reading time, gender, and gender characteristics).

Hypotheses about liking of presentation style

Sensation-seeking tendency

1.1 Among highly adventurous participants, those who read the Paged Hypertext (PH) will show higher scores on liking of presentation style than those who read the Scrolling Text (ST).

1.2 Among highly adventurous participants, subjects who read the Expanding Hypertext (EH) will exhibit higher scores on liking of presentation style than those who read Scrolling Text (ST).

Hypothesis 1.1 and 1.2 are based on the assumption that presentation of hyperlinks can be perceived as a stimulating factor ('high sensation value'). Donohew et al. (1998) suggested that messages high in sensation value should be more attractive to high sensation seekers. If so, it is logical to assume that high sensation values in information presentation style such as hyperlinks should engender more positive reaction from high sensation seekers.

Uncertainty orientation

1.3 While high uncertainty-oriented participants will show higher scores on liking of presentation style when reading from the Paged Hypertext (PH) than those who read the Scrolling Text (ST), those who are low in uncertainty orientation will show higher scores on liking of presentation style when reading from the ST than those who read PH.

1.4 While high uncertainty oriented participants will show higher scores on liking of presentation style when reading from the Expanding Hypertext (EH) than those who read the ST, those who are low in

uncertainty orientation will show lower scores in liking of presentation styles when reading from EH than those who read ST.

Hypothesis 1.3 and 1.4 are based on individuals' different cognitive characteristics and uncertainty orientation. It was argued that individuals have different styles of coping with internal and external uncertainties (Sorrentinao & Short, 1986). Uncertainty-orientation is defined as a tendency "to learn and incorporate new information in situations where there is uncertainty about the self and the environment" (Sorrentino, Holmes, Hanna, & Sharp, 1995, p.315). It is assumed that hyperlinks, particularly in PH or EH, create greater external uncertainty of what information will be presented next than ST and in turn will affect individuals' preference for presentation styles.

Computer use and efficacy

1.5 While participants who are high in computer use and efficacy will show higher scores on liking of presentation style when reading from the Paged Hypertext (PH) than those who read the Scrolling Text (ST), those who are low in computer use and efficacy will show higher scores on liking of presentation style when reading from the ST than those who read PH.

1.6 While participants who are high in computer use and efficacy will show higher scores on liking of presentation style when reading from the Expanding Hypertext (EH) than those who read the ST, those who are low in computer use and efficacy will show lower scores on liking of presentation styles when reading from EH than those who read ST.

Hypotheses 1.5 and 1.6 are based on the social cognitive theory that self-efficacy is one of the significant factors influencing human behavior (Bandura, 1982). Self-efficacy refers to one's belief in his or her ability to perform a particular task. It was found that individuals with higher self-efficacy tend to enjoy using computers and experience less computer anxiety (Compeau & Higgins, 1995). Because hypertext, particularly paged hypertext, is being employed in a number of ways on World Wide Web or other types of computer texts such as help files, it is assumed that individuals who have used computers and have confidence in their ability to perform computer tasks will like paged hypertext better than the other types, while those who are low in computer use and efficacy will like ST, a linear information presentation used in traditional book-reading styles.

Gender

1.7 Among those who read PH, the male subjects will exhibit higher scores on liking of presentation style than the female counterparts.

1.8 Among those who read ST, the female subjects will exhibit higher scores on liking of presentation style than the male counterparts.

These hypotheses were based on gender differences noted in performance on and attitudes toward computer-related tasks. It was found that females tend to like computers less than males (See Gender and Hypertext in the previous section) and exhibited higher levels of computer anxiety. It was speculated that it might be due to females' lower experience with computers. If so, it can be assumed that females will like ST over PH while males will exhibit preference of PH to ST.

Hypotheses about disorientation

Working memory capacity

2.1. While the participants who are low in working memory capacity who read PH will experience more disorientation than those who read ST, those who are high in working memory capacity will not show the same anticipated text format effect.

2.2. Among the participants who are low in working memory capacity, those who read EH will experience less disorientation than those who read PH.

Individuals' working memory capacity is assumed to be an influencing factor on how much disorientation is experienced by individuals who read different types of text format. It was suggested that hypertext tends to overload individuals' cognitive capacity and in turn creates disorientation. If so, this disorientation should be prominent among those who have low working memory capacity. Therefore, these hypotheses were developed.

Sensation-seeking tendency

2.3 Among the subjects who are low in adventurousness, those who read PH will experience more disorientation than those who read ST but those who are high in adventurousness will not show the same anticipated text format effect.

2.4 Among the subjects who are low in adventurousness, those who read EH will experience less disorientation than those who read PH.

These hypotheses were in line with Hypotheses 1.1 and 1.2. If hyperlinks are perceived as a stimulating factor, the presentation of hyperlinks with nonlinear information presentation might be perceived as too much to handle and create

disorientation among those who are not adventurous. Also, EH's hyperlinks with linear information presentation will be perceived as less disorienting than PH.

Need for cognition

2.5 Among the subjects who are low in need for cognition, those who read PH will experience more disorientation than those who read ST but those who are high in need for cognition will not show the same anticipated text format effect.

2.6 Among the subjects who are low in need for cognition, those who read PH will experience more disorientation than those who read EH.

Hypotheses 2.5 and 2.6 are based on the need for cognition literature. Need for cognition refers to individuals' different tendency "to engage in and enjoy effortful cognitive endeavors" (Cacioppo, Petty, Feinstein, & Jarvis, 1996, p.197). Here, it is assumed that PH, because of its nonlinear information presentation, tends to create a high level of disorientation, in particular, among individuals who don't enjoy effortful thinking. In other words, disorientation among individuals who are high in need for cognition would be compensated for, by their tendency to enjoy effortful thinking.

Uncertainty orientation

2.7 While among the subjects who are low in uncertainty orientation, those who read PH will experience more disorientation than those who read ST, those who are high in uncertainty orientation will not show the same anticipated text format effect.

2.8 Among the subjects who are low in uncertainty orientation, those who read PH will experience more disorientation than those who read EH.

These hypotheses were in line with Hypotheses 1.3 and 1.4. Learning materials with the hyperlinks that present information nonlinearly can be perceived as an uncertain environment. If individuals exhibit a strong tendency to integrate new information with their existing knowledge and a high levels of ability to deal with uncertainty, their ability to deal with uncertainty about what information would be presented next might compensate for PH's possible disorientation; this might not be the case among those who are low in uncertainty orientation.

Computer use and efficacy

2.9 Among the subjects who exhibit low computer use and efficacy, those who read PH will experience more disorientation than those who read ST but those who show a high computer use and efficacy will not show the same anticipated text format effect.

2.10 For those who are low in computer use and efficacy, those who read EH will experience less disorientation than those who read PH.

Hypotheses 2.9 and 2.10 are in line with the previous Hypotheses 1.5 and 1.6 in that the disorientation caused by PH's nonlinear information presentation might be compensated for individuals' previous experience with a computer and their belief in their ability to perform computer tasks.

Hypertext familiarity and knowledge

2.11 Among the subjects who are low in hypertext familiarity and knowledge, those who read PH will experience more disorientation than those who read ST but those who are high in hypertext familiarity and knowledge will not show the same anticipated text format effect.

2.12 For the subjects who had lower hypertext familiarity and knowledge scores, those who read EH will experience less disorientation than those who read PH.

Individuals' previous experience and knowledge of a system is known as a critical factor in computer-related performance (Jacobson & Fusani, 1992). Therefore, it was assumed that high levels of hypertext familiarity and knowledge would be compensating for possible disorientation that might have been caused by nonlinear information presentation.

Content familiarity (domain knowledge)

2.13 Among the participants who are not familiar with the content, those who read the PH will show more disorientation than those who read ST but those who are quite familiar with the content will not show the same anticipated text format effect.

2.14 Of the participants who are low in content familiarity, those who read EH will exhibit less disorientation than those who read PH.

Hypertext's disorientation problem has been noted particularly with those who exhibited low levels of domain knowledge (MaDonald, 1998; Last, O'Donnell, & Kelly, 1998; Shin, Schallert, & Savenye, 1994). It is assumed that participants' previous knowledge of the content (content familiarity) will compensate for possible disorientation caused by PH.

Gender

2.15 Female participants will tend to experience more disorientation when they read PH than the male counterparts.

This hypothesis is in line with the previous Hypotheses 1.9 and 1.10. It was assumed that female participants will experience more disorientation while reading PH because they tend to report less experience with computers, lower computer efficacy, and higher levels of computer anxiety.

Hypotheses about comfort with presentation style

Hypotheses regarding how comfortably the participants were able to read through the texts were in line with the previous hypotheses regarding disorientation. Therefore, the descriptions of each hypothesis are not presented in this section.

Working memory capacity

3.1 Among the subjects who are low in working memory capacity, those who read PH will report lower levels of comfort with the presentation style than those who read ST but those who are high in working memory capacity will not show the same anticipated text format effect.

3.2 Among the participants who are low in working memory capacity, the subjects who read EH will exhibit higher levels of comfort with the presentation style than those who read PH.

Sensation-seeking tendency

3.3 Among highly adventurous participants, those who read PH will exhibit higher levels of comfort with presentation style than those who read ST.

3.4 Among highly adventurous participants, the subjects who read EH will exhibit higher levels of comfort with presentation style than those who read ST.

3.5 Among those who are low in adventurousness, the subjects who read ST will exhibit higher levels of comfort with presentation style than those who read PH.

3.6 Among those who are low in adventurousness, the subjects who read EH will exhibit higher levels of comfort with presentation style than those who read PH.

Need for cognition

3.7 Among the subjects who are low in need for cognition, those who read PH will exhibit lower levels of comfort with presentation style but those who are high in need for cognition will not show the same anticipated text format effect.

3.8 For those who are low in need for cognition, those who read EH will exhibit higher levels of comfort with presentation style than those who read PH.

Uncertainty orientation

3.9 Among the subjects who are low in uncertainty orientation, those who read PH will show lower levels of comfort with presentation style than those who read ST but the subjects who are high in uncertainty orientation will not show the same anticipated text format effect.

3.10 Among the subjects who are low in uncertainty orientation, those who read EH will show lower levels of comfort with presentation style than those who read PH.

Computer use and efficacy

3.11 Among the subjects who exhibit high computer efficacy, the subjects who read PH will report higher levels of comfort with presentation style than those who read ST.

3.12 Among the subjects who have low computer use and efficacy, the subjects who read EH will exhibit higher levels of comfort with presentation style than those who read PH.

Hypertext familiarity and knowledge

3.13 Among the subjects who have higher levels of hypertext familiarity and knowledge, those who read PH or EH will exhibit higher levels of comfort with presentation style than those who read ST.

Content familiarity (domain knowledge)

3.14 When reading PH, those who are not familiar with the content will be less comfortable with presentation style than those who are familiar with the content.

3.15 Among those who are not familiar with the content, those who read ST or EH will exhibit higher levels of comfort with presentation style than those who read PH.

Gender

3.16 The female subjects who read ST or EH will exhibit higher levels of comfort with the presentation style than those who read PH.

3.17 The male subjects who read PH will exhibit higher levels of comfort with presentation style than the female counterparts.

Hypotheses about recognition as a function of learning

Working memory capacity

4.1 Of the subjects who are low in working memory capacity, those who read ST will have higher recognition scores than those who read PH.

4.2 Among those who are low in working memory capacity, the subjects who read EH will have higher recognition scores than those who read PH.

If hypertext's nonlinear information presentation overloads individuals' cognitive capacity, disorientation should become prominent among those who have lower cognitive capacity such as working memory capacity, thus interfering with recognition. Furthermore, it is assumed that hyperlinks, which keep the linearity of a text, will compensate individuals' low working memory capacity and produce better learning performance (higher recognition scores).

Sensation-seeking tendency

4.3 Among highly adventurous participants, the subjects who read EH will have higher recognition scores than those who read PH.

4.4 Among highly adventurous participants, the subjects who read PH will have higher recognition scores than those who read ST.

4.5 Among those who are not adventurous, the subjects who read PH will have lower recognition scores than those who read EH or ST.

Hypotheses 4.3, 4.4, and 4.5 were in line with the previous hypotheses. It is assumed that participants who are highly adventurous will like PH better, feel less disorientation, and feel high levels of comfort. In turn, they will produce higher recognition scores than those who read ST.

Need for cognition

4.6 While among the subjects who are low in need for cognition, those who read PH will have lower recognition scores than those who read ST, those who are high in need for cognition will not show the same effect.

This hypothesis is based on the assumption that individuals' high need for cognition will compensate for PH's disorientation, reducing the effect of disorientation on recognition. Thus, those who don't enjoy thinking of how information is interconnected will experience disorientation when reading PH and in turn would produce lower recognition scores.

Uncertainty orientation

4.7 Of the individuals who are low in uncertainty orientation, those who read PH will show lower recognition scores than those who read ST.

4.8 Of the individuals who are low in uncertainty orientation, those who read EH will have lower recognition scores than those who read ST.

These hypotheses are in line with the previous hypotheses in that individuals' high uncertainty orientation will compensate for PH's possible disorientation effects and

in turn produce better learning. However, this would not be the case among those who are low in uncertainty orientation.

Computer use and efficacy

4.9 Among the subjects who exhibit low computer use and efficacy, those who read ST will have higher recognition scores than those who read PH, but for those who are high in computer use and efficacy, those who read PH will show higher scores than those who read ST.

4.10 Among the subject who are low in computer use and efficacy, the subjects who read EH will exhibit higher recognition scores than those who read PH.

Hypotheses 4.9 and 4.10 were in line with the previous hypotheses in that individuals who have used computers and have confidence in their ability to perform computer tasks will like paged hypertext better than the other types, and this, in turn, will produce better learning, while those who are low in computer use and efficacy will like ST, a linear information presentation that has been used in traditional book reading styles, in turn producing better learning.

Hypertext familiarity and knowledge

4.11 Among the subjects who have low levels of hypertext familiarity, those who read ST will have higher recognition scores than those who read PH or EH.

Hypertext familiarity and knowledge is assumed to be a critical factor that influences how much individuals learn from hypertext. It is assumed that if individuals don't have previous experience or knowledge, reading from traditional linear text (ST) will produce better learning than when they read the other hypertexts.

Content familiarity (domain knowledge)

4.12 Among those who are low in content familiarity, those who read the PH will have lower recognition scores than those who read ST, but for those who are high in content familiarity, the same effect will not occur.

4.13 For those who are low in content familiarity, those who read EH will exhibit higher recognition scores than those who read PH.

As previously mentioned, individuals' content familiarity or domain knowledge is assumed to compensate for hypertext's disorientation effects. However, among individuals who are not familiar with content, those who read PH will experience disorientation and in turn will have lower recognition than those who read ST. Also, EH's hyperlinks, which keep the linearity of a text, will compensate for possible disorientation that might be caused by PH.

Gender

4.14 Of those who read PH, the males who read PH will produce higher recognition scores than the females.

Hypothesis 4.14 was in line with the previous hypotheses and based on gender differences noted in the literature. For example, Lee (1998 and 1999) found that male students who read PH exhibited higher recognition scores than the female students.

CHAPTER 3
METHODOLOGY

Specifically, this study investigated the effects of different computer text formats on the participants' recognition of given information. The participants were college students who varied in adventurous sensation-seeking tendency and other personality and cognitive traits such as need for cognition and uncertainty orientation.

The experimental design was a post-test model with three variations of computer text formats. Before the experiment, the participants were asked to answer a questionnaire about their sensation-seeking tendencies, need for cognition, uncertainty orientation, and other personality traits. Although the stimulus manipulation was considered not likely to influence the results of the reading span tests and other personality and cognitive trait tests, those tests were given before the stimulus.

The computer manipulation involved reading three somewhat unrelated articles in one of the three formats: scrolling text, expanding hypertext, and paged hypertext. After the subjects finished reading, they were asked to take the Reading Span test and factual recognition tests. Three versions of the Reading Span Test that were designed similarly to the ones used by Carpenter and Just (1989), were used to measure subjects' working memory span. Unrelated sentences were incrementally presented, followed by a question about the last word(s) of each sentence(s). In addition, after each question about the last word, a question about content was presented to assure the subject read the complete sentence ('an accuracy test').

In the experiment, each subject was randomly assigned to one of three groups, corresponding to the three text formats (Figure 2). The order of the articles were randomly mixed by the computer program to control for a possible order effect.

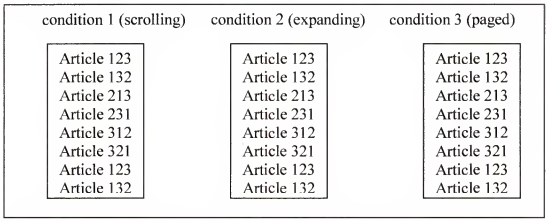

Figure 2. The experimental design

Study Design

Subjects were randomly assigned to one of the three conditions: scrolling text, expanding hypertext, or paged hypertext. Each condition included the same text content, only organized in the respective styles. The researcher explained the test procedures at the beginning of the study and subjects were told to click all links and read the text completely before clicking a 'finished' button. The participants were not allowed to go back to the readings after they began the recognition test.

A letter from the researcher explained the study when subjects sat down in front of a computer and a 'start' button randomly lead each subject to one of the three conditions (Figure 3). As mentioned earlier, the order in which the three articles were

presented was randomized to control for a possible article order effect. The amount of time each subject spent on each screen of each article as well as which links he/she clicked and in what order were recorded by the computer program presenting the articles. The experiment was conducted in a computer lab with twenty computers at the University of Florida and each session took approximately from 35 minuets to 50 minutes.

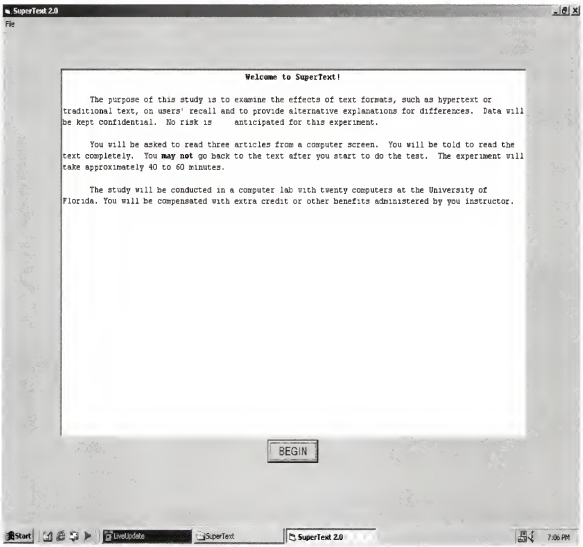

Figure 3. The first screen of the computer program

Before the subjects started reading the three articles, they were asked to take three reading span tests, followed by the sensation- seeking tendency tests, other measurements of cognitive and personality traits, and ending with demographic questions.

Three versions of the Reading Span test were given. Each test used a black computer screen with unrelated sentences centered in large yellow type (Figure 4). The sentences were presented for approximately four seconds each, followed by prompts for the subject to remember and enter the last word of each sentence. Each test began in this manner with one sentence, then two, three, four, and five sentences. Each series of sentence displays and questions were followed by a question about content to assure the subject read the complete sentence (an accuracy test). When the subject finished answering the last question, the computer program displayed one of the articles in one of three different text formats (scrolling text, expanding hypertext, or paged hypertext).

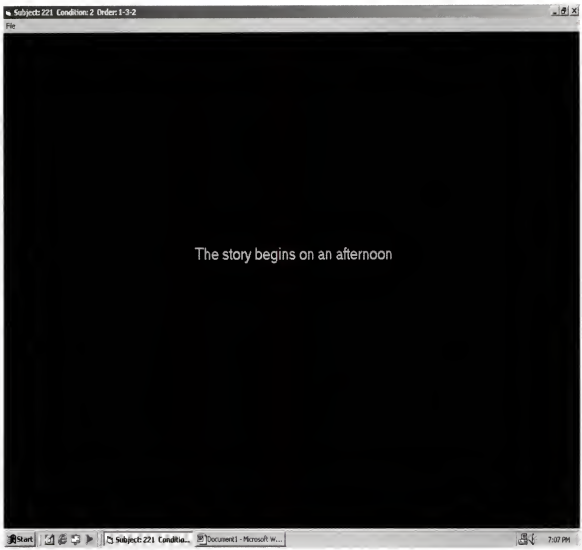

Figure 4. Example of reading span test

In condition 1, the articles were presented in linear text format with the scrolling bar on the right hand side that allowed going back to the previous information (Figure 5). After the subjects finished reading, they clicked on the button "Finished" that automatically lead subjects to a set of questions measuring content interest, content

familiarity, disorientation, and a level of comfort with the presentation style, followed by the recognition test.

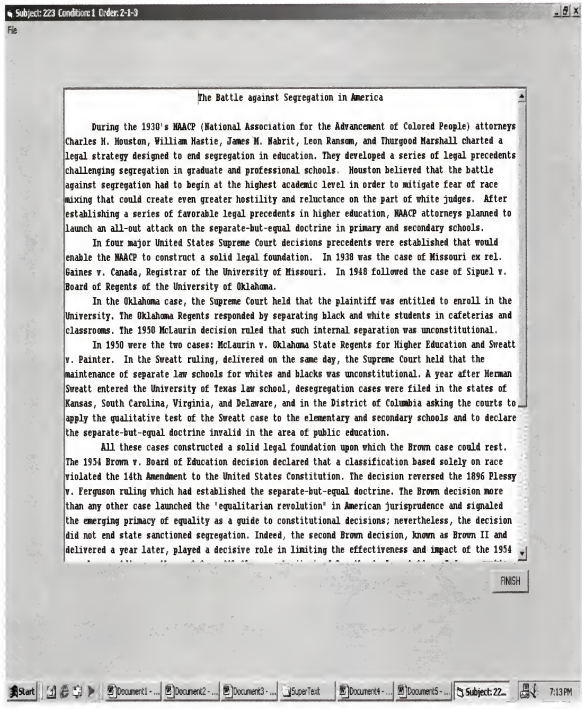

Figure 5. Example of scrolling text

In condition 2, the articles were presented in an expanding-hypertext format. The expanding-hypertext consisted of links that allowed the reader to have more detailed information without losing the linear flow of information. This was achieved by links from highlighted, underlined key terms in the text (Figure 6). These links expanded or added more detailed information (Figure 7). The participant was able to click on links for more detailed information. As in condition 1, the scrolling bar on the right hand side allowed referring back to the previous information. After the subjects finished reading, they clicked on the button "Finished" that automatically lead subjects to a set of questions measuring content interest, content familiarity, disorientation, and a level of comfort with the presentation style, followed by the recognition test.

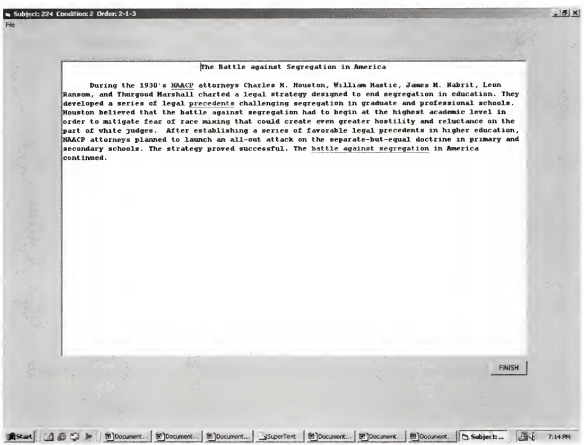

Figure 6. Example of expanding hypertext – first screen

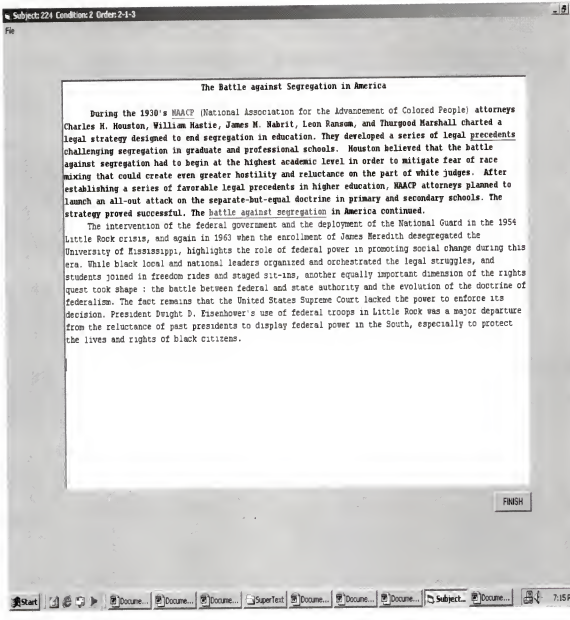

Figure 7. Example of expanding hypertext - second screen

In condition 3, the articles were presented in a paged-hypertext format. The texts were presented with each excerpt on its own screen (Figure 8 and 9). The participant was able to navigate between excerpts by clicking on highlighted, underlined terms, serving as links. No structure was used between links. Instead, wherever a term existed in the

article for which an elaborating excerpt existed, a link was presented. This created a web-like, user navigated architecture of links where looping was possible. In this condition, a "Back" button was available for the reader to return to previous screens, as would be found in a web-browser or Windows Help file. After the subjects finished reading, they clicked on the button "Finished" that automatically lead subjects to a set of questions measuring content interest, content familiarity, disorientation, and a level of comfort with the presentation style, followed by the recognition test.

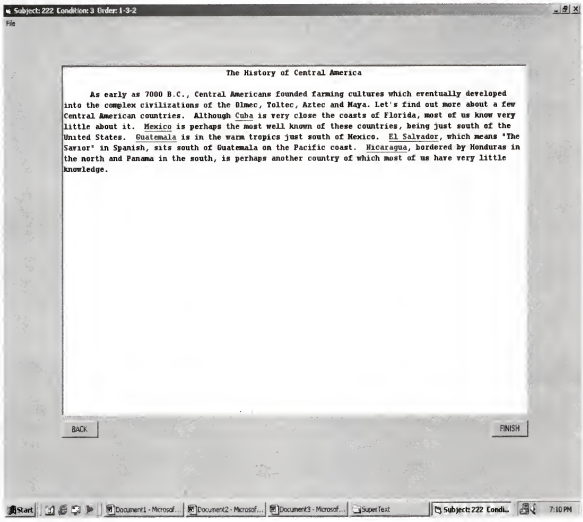

Figure 8. Example of paged hypertext – first screen

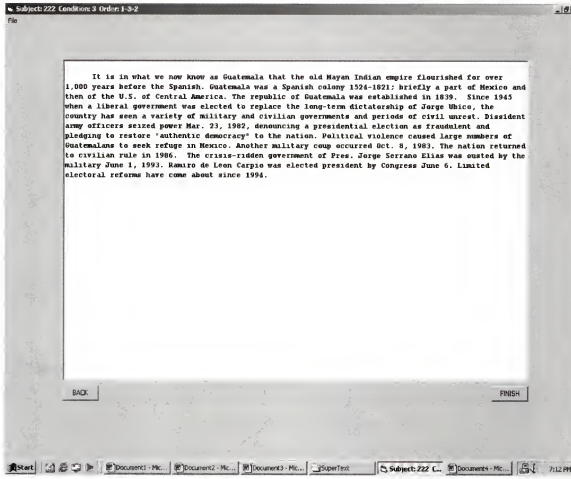

Figure 9. Example of paged hypertext –second screen

Subjects

Two hundred one undergraduate students from the College of Journalism and Communications were tested during April of 2001. The participants were compensated with extra credit for a course. Of the 201 participants, 71% (N = 143) of subjects were white, 13% (N = 26) were Hispanic American, 4% (N = 7) were Asian or Pacific Islander, and 8% (N = 16) were African American. Ninety-four percent of the subjects were between 19 and 23 years old. Seventy-four percent were female (N = 150) and 26% were male (N =51).

CHAPTER 4
DATA ANALYSIS

The purpose of the analyses was to find out whether presentation of the same information in different text formats affected subjects' recognition scores and if these scores varied according to the subjects' working memory capacity, sensation-seeking tendency, need for cognition, uncertainty orientation and gender and gender characteristics. In addition, data were collected to describe subjects' computer use and efficacy, hypertext familiarity and knowledge, content familiarity (domain knowledge), and content interest.

GLM analysis was used to test the effects of the different text formats with gender, working memory span, sensation-seeking tendencies, computer use and efficacy, need for cognition, uncertainty orientation, hypertext familiarity and knowledge, and subjects' total reading time. In addition to the recognition scores, the previously mentioned independent variables were tested on the participants' liking of the presentation style, disorientation, and comfort with the presentation style.

Working Memory

The results of the initial three reading span tests were submitted for a reliability test and resulted in a Cronbach's alpha of .82. The results of the three reading span tests were added to create a reading span index, which was used for further analysis. The average reading span was 4 with a minimum of 2 and a maximum of 5 with a standard

deviation of .72. The index had an average score of 11, a minimum of 8, and a maximum of 15 with a standardized deviation of 1.6.

Sensation-Seeking Indices

For the sensation-seeking items, a principal axis factor analysis with oblimin rotation revealed three factors: "rebelliousness"[1] (32% of variance explained, Cronbach's $\underline{\alpha}$ = .82), "impulsiveness"[2] (16% of variance explained, Cronbach's $\underline{\alpha}$ = .78), and "adventurousness"[3] (14% of variance explained, Cronbach's $\underline{\alpha}$ = .78). These factors are consistent with the factors in earlier research. In this study, only adventurousness, one of these three types, was tested for the hypotheses because, compared to the other two sensation-seeking tendencies, adventurousness was considered to better fit the nature of the study in the context of learning. As a tendency of enjoying challenges and exciting experiences, adventurousness seemed closely related to their exploration and learning in hypertext systems. However, impulsiveness (a tendency of disliking of thinking) and rebelliousness (a tendency of rebelling against social norms) seemed not to be predictors of learning tendency regardless of different types of learning systems.

A summed-index of factor scores was created based on the factor analysis. To test the validity of these results with regard to earlier studies, gender and sensation-

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[1] Those items are "I like people who are partiers," "I like wild and uninhibited parties," "Having lots of alcohol is the key to a really good party," and " I am likely to drive after I have had several drinks."

[2] The items are "I often get into a jam because I do things without thinking," I often do things on the spur of the moment," I mostly speak before thinking things out," and "I get so "carried away" by new and exciting ideas, I never think of possible snags."

[3] The items are "I like adventure," "I welcome new and exciting experiences, even if they are a little frightening," "I like challenges," and "I enjoy or would enjoy skydiving."

seeking were examined. As has been found in other studies, the participants' gender had a significant relationship with adventurousness, t (201) = 4.4, $p < .001$. Overall, male participants had significantly higher scores on adventurousness (M [male] = .42 vs. M [female] = -.15 and SD [male] = .75 vs. SD [female] = .95) than did females. As anticipated from previous findings, adventurousness was correlated with the other types; adventurousness had a positive correlation with rebelliousness, r (201) = .39, $p < .001$, but a somewhat weak correlation with impulsiveness, r (201) = .16, $p < .03$.

Need for Cognition

For the need-for-cognition items, the initial ten items were tested for reliability; eight items[4] were used to create a final need-for-cognition scale with a Cronbach's alpha of .78 from a summed-index of factor scores. Two items were dropped due to the low reliability scores. They were: "It is enough for me that something gets the job done; I don't care how or why it works." and "I like tasks that require little thought once I've learned them."

Participants' need for cognition was correlated with their adventurousness, r (201) = .39, $p < .001$. Gender also had a significant relationship with need for cognition, t (201) = 2.1, $p < .02$. Overall, male participants had significantly higher scores on need

[4] Those eight items were "I really enjoy a task that involves coming up with new solutions to problems," " The notion of thinking abstractly is appealing to me," "I would prefer complex to simple problems," "I like to have the responsibility of handling situation that requires a lot of thinking," "Thinking is my idea of fun," "I would prefer intellectual, difficult, and important to one that is somewhat important but does not require much thought," "I find satisfaction in deliberating hard and for long hours," and "I usually end up deliberating about issues even when they do not affect me personally."

for cognition (M [male] = .23 vs. M [female] = - .08 and SD [male] = .91 vs. SD [female] = .92).

Uncertainty Orientation

For the uncertainty orientation items, the ten items were initially tested for scale reliability and nine items[5] were used to create a final uncertainty orientation scale with a Cronbach's alpha of .72 from a summed-index of factor scores.

As anticipated, uncertainty orientation has a positive correlation with need for cognition, $r(201) = .69$, $p < .001$, and adventurousness, $r(201) = .50$, $p < .001$.

Gender also had a significant relationship with uncertainty orientation, $t(201) = 2.2$, $p < .02$. Overall, male participants had significantly higher scores on uncertainty orientation (M [male] = .23 vs. M [female] = - .007 and SD [male] = .91 vs. SD [female] = .83.

Computer Use and Efficacy

For the computer use and efficacy items, a principal axis factor analysis with oblimin rotation revealed only one factor (Table 1). A summed-index of factor scores was created and labeled, "computer use and efficacy" (64.6% of variance explained, Cronbach's $\alpha = .90$).

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[5] The items are "I try to resolve inconsistencies in beliefs I hold," "I evaluate people on their own merit without comparing them to others," "When I obtain new information, I try to integrate it with information I already have," "If someone suggests an opinion that is different than mine, I do not reject it before I consider it," "I would like a job which would requires a lot of traveling," "I sometimes take different routes to a place I often go, just for variety's sake," "If given a choice, I prefer to go somewhere new rather than somewhere I've been before," "I sometimes enjoy being in an unknown situation," "I like tasks that involve coming up with new solutions to problems."

Table 1. Factor Loadings of Computer Use and Efficacy Items

Questions	Factor 1
I spend a lot of time doing things on a computer.	.87
I enjoy using computers	.85
I like a computer	.82
I am good at learning skills related to a computer.	.82
I enjoy searching information on the internet.	.77
I feel confident in dealing with computers.	.74
I would rather spend my time in doing something else than doing things on a computer. (reverse coded)	.46
% of variance explained	65%
Cronbach's α	.90

Extraction Method: Principal Axis Factoring.
a 1 factors extracted. 5 iterations required.

Hypertext Familiarity and Knowledge

To create an index of hypertext familiarity and knowledge measures, a principal axis, oblimin rotation factor analysis of subjects' level of hypertext knowledge, familiarity with the term "hypertext," access to the Internet, time spent viewing websites, computer use, comfort with a computer screen and computer ownership was conducted. Two items, computer ownership and Internet access, were dropped from the scale because everyone reported that they had access to Internet and almost everyone (except five participants) said that they had a computer. The five remaining items[6] were submitted to a reliability test (α = .66) and used to create a hypertext familiarity and knowledge scale from a summed-index of factor scores.

[6] The items are: "Estimate the average amount of time you spend each day looking at Internet, World Wide Web (WWW) sites," "How familiar are you with the term hypertext?", "What is your highest level of hypertext knowledge? (Choose one.)", "How comfortable are you reading text from a computer screen?" and "If you have used hypertext, how would you react to the following statement: Hypertext documents are easier to read than normal documents."

Total Reading Time

The scale of total reading time was created by adding together how much time it took for a participant to read each article (how long the text was exposed to them for reading), calculated in seconds. The minimum time was 37 sec. while the maximum time was 1929 sec. with a median of 455 sec. and a standard deviation of 236 sec.

Recognition Scores

Of the 48 questions testing recognition for the three articles, the minimum number correct was 9 and the maximum correct was 40, with a mean of 23 and a standard deviation of 6.6.

An additive index for recognition scores was created. This summed index represented the total number of questions answered correctly for all three articles.[7]

For the 16 questions testing recognition for the Central America article (CA), the minimum correct was 1 and the maximum correct was 15 with a mean of 7.4 and a standard deviation of 3.1. Of the 16 questions testing recognition for the Affirmative Action article (AA), the minimum correct was 0 and the maximum correct was 15 with a mean of 7.6 and a standard deviation of 2.9. Of the 16 questions testing recognition for the Two Fields of Psychology article (PS), the minimum correct was 2 and the maximum correct was 15 with a mean of 7.8 and a standard deviation of 2.8.

All three indices were correlated with each other. CA was correlated with AA, r (201) = .42, $p < .001$, and PS, r (201) = .31, $p < .001$. Also, AA and PS were positively correlated, r (201) = .36, $p < .001$.

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[7] A reliability analysis for the 48 multiple choice questions showed that the standardized Crombach's alpha was .73.

Other Dependent Variables

The items intended for each index were factor analyzed using principal axis factoring with an oblimin rotation. A one-factor solution was used to create a factor score for each index.

Interest in content. Four questions were used to create an index of interest participants experienced from each article: "I liked this article," "I would like to read more about this topic," "The article was interesting," and "The article was informative" (53% of variance explained, Cronbach's $\alpha = .86$).

Disorientation. For measuring the degree of disorientation the participants experienced while they read the articles, five questions were used to create the index (81% of variance explained, Cronbach's $\alpha = .86$). They are: "While I was reading the articles, I sometimes got frustrated," "While I was reading the articles, I often felt lost, not knowing where I was," "While I was reading the articles, I had a hard time understanding it," "While I was reading the articles, I had a hard time keeping track of what I just read," and "While I was reading the articles, I often had a hard time deciding which link to click next."

Liking of presentation style. For measuring the participants' degree of liking related to presentation style, an index was created out of four items loaded on one factor (59% of variance explained, Cronbach's $\alpha = .77$). The questions were the following: "The way the articles were presented was stimulating," "I like the idea that I had more choices to click." "It was easy to read through information with the way the articles were presented," and " I like the way the articles were presented to me."

Comfort with presentation style. Next, an index for measuring participants' level of comfort with presentation style was created based on four items (58% of variance explained, Cronbach's $\alpha = .78$). The questions were the following: "I have previous experience with the way the information was presented here," "I was able to explore the article freely," "I had control over the materials I read," and "It was easy to read through information in the way the article was presented."

Familiarity with content. Two questions were used to evaluate the subject's familiarity with content. They were: "The information presented in the article was new to me (reverse coded)" and "The content was familiar." These two items were highly correlated with each other, $r\ (201) = .50$, $p < .001$.

Correlations among variables

Initially, correlation tests were conducted among the previously mentioned variables (Table 2). The hypertext familiarity and knowledge scale was positively correlated with need for cognition, $r\ (201) = .28$, $p < .001$. As anticipated, disorientation was negatively correlated with content familiarity, $r\ (201) = -.33$, $p < .001$, and liking of presentation style,

$r\ (201) = -.27$, $p < .001$. Furthermore, the participants' comfort with the presentation style was strongly correlated with liking of presentation style, $r\ (201) = .71$, $p < .001$, but negatively correlated with disorientation, $r\ (201) = -.29$, $p < .001$. As noted in Table 2, the participants' recognition scores were positively correlated with their working memory capacity, $r\ (201) = .24$,

$p < .001$, need for cognition, $r(201) = .08$, $p < .009$, and hypertext familiarity and knowledge, $r(201) = .17$, $p < .02$, but negatively correlated with disorientation, $r(201) = .18$, $p < .01$.

Table 2. Correlation table

		AD	WM	NC	UO	CUE	HFK	CF	LS	DO	CS	RE
	Cronbach α	**.78**	**.82**	**.78**	**.72**	**.90**	**.66**	--	**.77**	**.86**	**.78**	--
AD	Pearson	1.00										
	Sig.	.										
WM		.11	1.00									
	Sig.	.12	.									
NC		**.39**	.10	1.00								
	Sig.	**.01**	.16	.								
UO		**.50**	.09	**.69**	1.00							
	Sig.	**.01**	.23	**.01**	.							
CUE		.01	-.04	.09	.03	1.00						
	Sig.	.88	.59	.21	.78	.						
HFK		.06	-.02	**.28**	**.15**	-.04	1.00					
	Sig.	.39	.77	**.01**	**.04**	.59	.					
CF		.13	-.03	.04	**.16**	**-.14**	**.19**	1.00				
	Sig.	.06	.67	.55	**.03**	**.05**	**.01**	.				
LS		**.15**	-.04	.11	.13	.06	.02	.12	1.00			
	Sig.	**.04**	.59	.12	.06	.42	.76	.09	.			
DO		-.11	.07	-.07	-.09	-.07	**-.18**	**-.33**	**-.27**	1.00		
	Sig.	.13	.32	.30	.21	.30	**.01**	**.01**	**.01**	.		
CS		**.18**	-.04	.12	**.14**	-.04	.03	**.14**	**.71**	**-.29**	1.00	
	Sig.	**.01**	.56	.10	**.05**	.57	.63	**.05**	**.01**	**.01**	.	
RE		-.01	**.24**	**.18**	**.13**	-.06	**.17**	**.15**	-.02	**-.18**	.08	1.000
	Sig.	.86	**.01**	**.01**	**.06**	.39	**.02**	**.04**	.74	**.01**	.27	.
Male		**.42(.75)**	11(1.6)	**.24(.9)**	**.23(.9)**	**.2(1)**	**.29(1)**	34(7.6)	49(13)	57(26)	80(18)	23(6.9)
Female		**-.15(1)**	12(1.7)	**-.01(.9)**	**-.01(.8)**	**-.01(1)**	**-.01(.8)**	33(8.3)	46(16)	62(26)	75(21)	23(6.5)

Note: Statistically significant Rs are in bold.

Independent Variables: AD; Adventurousness, WM; Working Memory, NC; Need for Cognition, UO; Uncertainty Orientation, CUE; Computer Use and Efficacy, HFK; Hypertext Familiarity and Knowledge, and CF; Content Familiarity

Dependent Variables (Shaded Area): LS; Liking of Presentation Style, DO; Disorientation, CS; Comfort with Presentation Style, and Re; Recognition

CHAPTER 5
FINDINGS

In this section, the results of the hypotheses tests are reported. First, a set of hypotheses regarding liking of presentation style was tested, followed by the hypotheses about disorientation, comfort with presentation style, and recognition scores. A GLM model test and an independent samples t-test were used for testing the hypotheses.

Hypotheses about Liking of Presentation Style

There was a main text format effect on the participants' liking of presentation style, F (2, 201) = 9.8, $p < .01$. Further analysis revealed that those who read the paged hypertext (M =50.8, SD=14) or the expanding hypertext (M = 50, SD=15) showed higher scores in liking of presentation styles than those who read the scrolling text (M = 40.3, SD=15.6) (Table 3).

Sensation-Seeking Tendency

1.1 Highly adventurous participants who read the Paged Hypertext (PH) will show higher scores on liking of presentation style than those who read the Scrolling Text (ST).

There was a significant difference between PH and ST on liking of presentation style, t (46) = -2.8, $p < .01$, among highly adventurous participants. Among these participants, those who read the paged hypertext (M= 57.2, SD = 14.2) exhibited higher

scores than those who read the scrolling text (M= 42.3, SD = 18.9). Therefore, hypothesis 1.1 was supported.

1.2 Among highly adventurous participants, subjects who read the Expanding Hypertext (EH) will exhibit higher scores on liking of presentation style than those who read Scrolling Text (ST).

This hypothesis was not supported, t (50) = -1.4, p = .08[1]. Even though the mean score (M = 49.7, SD = 17.4) of the participants who read the expanding hypertext was greater than the average score for the scrolling text participants (M=42.3, SD =18.9), as expected, the statistical analysis was only a near significant level of .08, which makes it difficult to conclude with great confidence (Figure 10 and Table 3).

Table 3. Mean scores of liking of presentation style by text format and high adventurousness

	Liking of Presentation Style	
Text Formats	High Adventurousness	
Scrolling Text	40 (16)	42 (19)
Expanding Hypertext	50 (15)	50 (17)
Paged Hypertext	51 (14)	57 (14)

The numbers represent the mean scores for liking of presentation style and standardized deviation scores in the parentheses.

[1] In this study, a less than .05 p value was considered significant.

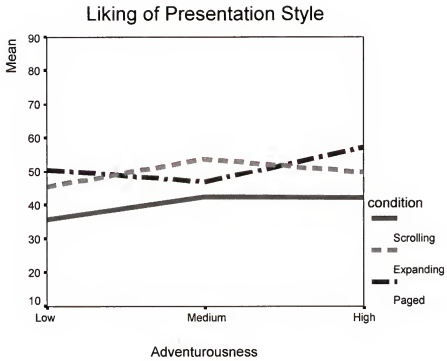

Figure 10. Text formats by adventurousness on liking of presentation style

Uncertainty Orientation

1.3 Highly uncertainty-oriented participants will show higher scores in liking of presentation style when reading from the Paged Hypertext (PH) than those who read the Scrolling Text (ST), but those who are low in uncertainty orientation will show higher scores in liking of presentation style when reading from the ST than those who read PH.

1.4 While highly uncertainty-oriented participants will show higher scores in liking of presentation style when reading from the Expanding Hypertext (EH) than those who read the ST, those who are low in uncertainty orientation will show lower scores in liking of presentation styles when reading from EH than those who read ST.

An interaction was expected, but it was not supported, F (4, 201) = .37, p = .88. In addition, it was noted that there was a significant uncertainty orientation effect on liking of presentation, F (2, 201) = 3.8, $p < .03$. Regardless of the text formats, those who were high in uncertainty orientation liked all the styles more than those who were not uncertainty oriented.

Computer Use and Efficacy

1.5 Participants who are high in computer use and efficacy will show higher scores in liking of presentation style when reading from the Paged Hypertext (PH) than those who read the Scrolling Text (ST), but those who are low in computer use and efficacy will show higher scores in liking of presentation style when reading from the ST than those who read PH.

1.6 Participants who are high in computer use and efficacy will show higher scores in liking of presentation style when reading from the Expanding Hypertext (EH) than those who read the ST, but those who are low in computer use and efficacy will show lower scores in liking of presentation styles when reading from EH than those who read ST.

A GLM model was used to test whether computer text formats (scrolling text, expanding hypertext, and paged hypertext) interacted with subjects' computer efficacy to affect how much participants liked the presentation style. There was no significant interaction effect, F (4, 201) = .39, p = .81, or computer efficacy effect on liking of presentation style, F (2, 201) = .10, p = .90. Regardless of the participants' computer use and efficacy, those who read the paged hypertext or expanding hypertext liked the style better than those who read the scrolling text. Therefore, Hypotheses 1.5 and 1.6 were not supported.

Gender

1.7 Among those who read PH, male participants will exhibit higher scores than females on liking of presentation style.

There was no significant gender effect on liking of presentation style among those who read PH, t (65) =.46, p = .65.

1.8 Among those who read ST, female participants will exhibit higher scores than males on liking of presentation style.

There was no significant gender effect on liking of presentation style among those who read ST, t (67) =1.38, p = .09.

Hypotheses about Disorientation

There was no significant main effect of the text formats on disorientation, F (2, 201) = .10, p = .90.

Working Memory Capacity

2.1 Participants who are low in working memory capacity who read PH will experience more disorientation than those who read ST, but those who are high in working memory capacity will not show the same anticipated text format effect.

2.2 Among the participants who are low in working memory capacity, those who read EH will experience less disorientation than those who read PH.

An interaction was anticipated, but it was not supported, F (4, 201) = .88, p = .47. Also there was no significant working memory capacity effect on disorientation, F (2, 201) = .32, p = .73.

Sensation-Seeking Tendency

2.3 Among the subjects who are low in adventurousness, those who read PH will experience more disorientation than those who read ST, but those who are high in adventurousness will not show the same anticipated text format effect.

2.4 Among the subjects who are low in adventurousness, those who read EH will experience less disorientation than those who read PH.

A GLM model was used to test whether computer text formats (scrolling text, expanding hypertext, and paged hypertext) interacted with subjects' adventurousness to affect how much participants experienced disorientation.

There was a significant interaction effect between the text formats and adventurousness, F (4, 201) = 3.6, $p < .01$. Further analysis revealed that among those who were low in adventurousness, participants who read the scrolling text experienced less disorientation (M =53, SD = 17.5) than those who read the expanding hypertext (M = 72.8, SD=25.8), t (56) = -3, $p < .002$. Paged hypertext fell in between them (M = 62.5, SD = 21). Independent samples t-tests showed a near-significant difference between the paged hypertext and the expanding hypertext, t (46) = 1.5, $p < .08$, or the scrolling text, t (42) = -1.6, $p < .06$. It is difficult to draw conclusions with great confidence from these findings (Table 4).

Among those who were medium in adventurousness, a significant difference existed between the expanding hypertext and the paged hypertext, t (50) = -1.6, $p < .05$. Those who read the expanding hypertext reported the least disorientation (M = 56, SD = 21.9) and those who read the paged hypertext reported the most disorientation (M = 68.7, SD =33.2). Furthermore, for those who are high in adventurousness, a significant difference was shown between the scrolling text and the paged hypertext, t (46) = 1.9, $p <$

.03. Those who read the scrolling text reported the most disorientation ($\underline{M}$ = 60.31, $\underline{SD}$ = 24) and those who read the paged hypertext reported the least disorientation ($\underline{M}$ = 45.4, $\underline{SD}$ = 28.7) (Figure 11).

Table 4. Mean scores of disorientation by text format and adventurousness

	Disorientation		
		Adventurousness	
	Low	Medium	High
Scrolling Text	53 (18)	66(20)	60 (24)
Expanding Hypertext	73 (26)	56(22)	69(33)
Paged Hypertext	63 (21)	69(33)	45(29)

The numbers represent the mean scores in disorientation and standardized deviation scores in the parentheses.

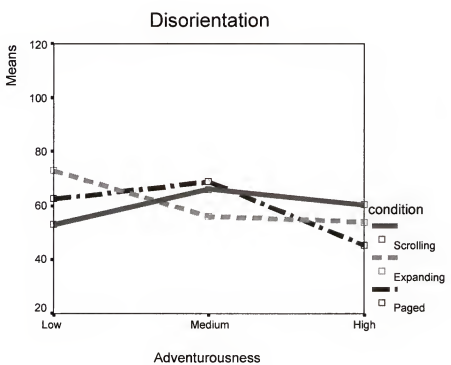

Figure 11. Text formats by adventurousness on disorientation

Need for Cognition

2.5 Among the subjects who are low in need for cognition, those who read PH will experience more disorientation than those who read ST, but those who are high in need for cognition will not show the same anticipated text format effect.

2.6 Among the subjects who are low in need for cognition, those who read PH will experience more disorientation than those who read EH.

There was neither an interaction effect, F (4, 201) = .36, $p < .84$, nor a need for cognition effect, F (2, 201) = 1.1, $p < .32$, on disorientation. These hypotheses were not supported.

Uncertainty Orientation

2.7 Among the subjects who are low in uncertainty orientation, those who read PH will experience more disorientation than those who read ST, but those who are high in uncertainty orientation will not show the same anticipated text format effect.

2.8 Among the subjects who are low in uncertainty orientation, those who read PH will experience more disorientation than those who read EH.

There was no significant interaction, F (4, 201) = .6, $p < .7$, or uncertainty orientation effect, F (2, 201) = 2.07, $p < .13$, on disorientation.

Computer Use and Efficacy

2.9 Among the subjects who exhibit low computer use and efficacy, those who read PH will experience more disorientation than those who read ST, but

those who show high computer efficacy will not show the same anticipated text format effect.

2.10 For those who are low in computer use and efficacy, those who read EH will experience less disorientation than those who read PH.

There was no significant interaction, F (4, 201) = .11, $p < .98$, or computer use and efficacy effect, F (2, 201) = 1.0, $p < .36$, on disorientation.

Hypertext Familiarity and Knowledge

2.11 Among the subjects who are low in hypertext familiarity and knowledge, those who read PH will experience more disorientation than those who read ST, but those who are high in hypertext familiarity and knowledge will not show the same anticipated text format effect.

2.12 For the subjects who had lower hypertext familiarity and knowledge scores, those who read EH will experience less disorientation than those who read PH.

A GLM model was used to test whether computer text formats (scrolling text, expanding hypertext, and paged hypertext) interacted with subjects' hypertext familiarity and knowledge to affect how much participants experienced disorientation.

There was a significant interaction shown, F (4, 201) = 3.2, $p < .01$. For the subjects who were low in hypertext familiarity and knowledge, further analysis revealed a significant difference between those who read the expanding hypertext and the paged hypertext, t (63) = -2.1, $p < .02$, in that those read the expanding hypertext reported the least disorientation (M = 53.9, SD =22.7) and those who read the paged hypertext reported the most disorientation (M =71.7, SD = 32.4) (Table 5).

For those who were medium in hypertext familiarity and knowledge, the significant difference existed between those who read the scrolling text and those who read the expanding hypertext, t (46) = -2.3, $p < .02$. Those who read the scrolling text reported the least disorientation (M = 59.3, SD = 16.5) while those who read the expanding hypertext reported the most disorientation (M = 73.8, SD = 27). Even though there is a near significant difference between those who read the expanding and the paged hypertexts, t (51) = 1.5, $p < .08$, it is difficult to draw conclusions from these findings with great confidence.

For those who were high in hypertext familiarity and knowledge, a significant difference was shown between those who read the scrolling text and the paged hypertext, t (42) = 2.0, $p < .03$. Those who read the paged hypertext reported the least disorientation (M = 44.2, SD = 19) while those who read the scrolling text reported the most disorientation (M = 57, SD = 22.9) (Figure 12).

Table 5. Mean scores of disorientation by text format and hypertext familiarity and knowledge

	Disorientation		
	Hypertext Familiarity Knowledge		
	Low	Medium	High
Scrolling Text	61(25)	59(17)	57 (23)
Expanding Hypertext	54 (23)	74 (17)	57 (23)
Paged Hypertext	72(32)	61(25)	44(19)

The numbers represent the mean scores in disorientation and standardized deviation scores in the parentheses.

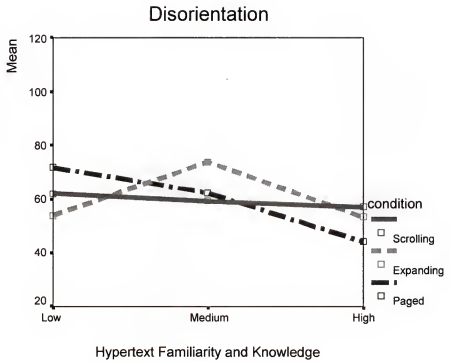

Figure 12. Text formats by hypertext familiarity and knowledge on disorientation

Content Familiarity (Domain Knowledge)

2.13 Among the participants who are not familiar with the content, those who read the PH will show more disorientation than those who read ST, but those who are familiar with the content will not show the same anticipated text format effect.

There was no significant interaction, F (4, 201) = .7, p = .60, but a significant content familiarity effect, F (2, 201) = 6.6, p < .002, on disorientation. When reading PH, those who were familiar with the content reported less disorientation than those who were not familiar with the content, F (2, 64) = 2.86, p < .06. However, this effect consistently showed regardless text format. Therefore, this hypothesis was not supported.

2.14 For the participants who are low in content familiarity, those who read EH will exhibit less disorientation than those who read PH.

This hypothesis was not supported, $\underline{t}$ (51) = .56, $\underline{p}$ = .17, due to the large variance even though the mean scores exhibited a similar pattern (PH: $\underline{M}$ = 72.4 and $\underline{SD}$ = 27.4 and EH: $\underline{M}$ = 65.3 and $\underline{SD}$= 25.6).

Gender

2.15 The female subjects will tend to experience more disorientation when they read PH than their male counterparts.

There was a significant gender effect on disorientation, $\underline{t}$ (65) = 17.8, $\underline{p}$ < .05. In general, females reported higher scores ($\underline{M}$ = 62, $\underline{SD}$ = 2.1) in disorientation than males ($\underline{M}$ = 57, $\underline{SD}$ = 3.7) regardless of the text format as expected (Figure 13).

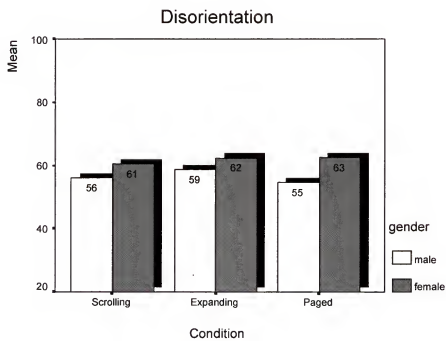

Figure 13. Text formats by gender effects on disorientation

Hypotheses about Comfort with Presentation Style

There was a main text format effect on the participants' levels of comfort with presentation style, F (2, 201) = 8.8, $p < .001$. Further analysis revealed that those who read the paged hypertext (M = 83, SD = 18.9) reported the highest scores in comfort with presentation style, followed by those who read the expanding hypertext (M = 77.9, SD = 19.6). The participants who read the scrolling text reported the lowest scores (M = 68.8, SD = 21).

Working Memory Capacity

3.1 Among the subjects who are low in working memory capacity, those who read PH will show lower levels of comfort with the presentation style than those who read ST, but those who are high in working memory capacity will not show the same anticipated text format effect.

3.2 Among the participants who are low in working memory capacity, the subjects who read EH will exhibit higher levels of comfort with the presentation style than those who read PH.

There was no significant interaction, F (4, 201) = .5, p = .80, or working memory capacity effect, F (2, 201) = .9, p = .40, shown on comfort with presentation style. Therefore, these hypotheses were not supported.

Sensation-Seeking Tendency

3.3 Among highly adventurous participants, those who read PH will exhibit higher levels of comfort with presentation style than those who read ST.

3.4 Among highly adventurous participants, the subjects who read EH will exhibit higher levels of comfort with presentation style than those who read ST.

These hypotheses were both supported, F (2, 66) = 5.9, $p < .004$. Differences were found at all comparisons. For the subjects who were high in adventurousness, those who read the paged hypertext reported the highest comfort with presentation style (M = 94.4, SD = 22.9), followed by the subjects who read the expanding hypertext (M = 80.7, SD = 22.1). The subjects who read ST exhibited the lowest levels of comfort with presentation style (M = 71.9, SD = 21.3).

3.5 Among those who are low in adventurousness, the subjects who read ST will exhibit higher levels of comfort with presentation style than those who read PH.

3.6 Among those who are low in adventurousness, the subjects who read EH will exhibit higher levels of comfort with presentation style than those who read PH.

Hypotheses 3.5 and 3.6 were not supported even though there was a significant text format effect on comfort with presentation style among the subjects who were low in adventurousness, F (2, 66) = 4.1, $p < .02$. In fact, the results came out opposite. The participants who read PH (M = 81, SD = 14) or EH (M = 74.4, SD = 22.2) exhibited higher levels of comfort with presentation style than those who read ST (M = 64, SD = 21).

Need for Cognition

3.7 Among the subjects who are low in need for cognition, those who read PH will exhibit lower levels of comfort with presentation style, but those who are

high in need for cognition will not show the same anticipated text format effect.

3.8 For those who are low in need for cognition, those who read EH will exhibit higher levels of comfort with presentation style than those who read PH.

These two hypotheses were not supported. There was no significant interaction, F (4, 201) = .45, p = .77, but a near significant need for cognition effect, F (2, 201) = 2.9, p < .06. Regardless of the participants' need for cognition, those who read PH or EH exhibited higher levels of comfort with presentation style than those who read ST. Furthermore, regardless of the text formats, those who were high in need for cognition reported higher scores in comfort with presentation type than those who were low in need for cognition.

Uncertainty Orientation

3.9 Among the subjects who are low in uncertainty orientation, those who read PH will show lower levels of comfort with presentation style than those who read ST, but the subjects who are high in uncertainty orientation will not show the same anticipated text format effect.

3.10 Among the subjects who are low in uncertainty orientation, those who read EH will show lower levels of comfort with presentation style than those who read PH.

There was no significant interaction, F (4, 201) = .10, p = 1.0, and no significant uncertainty orientation effect on participants' level of comfort with presentation style, F (2, 201) = 2.2, p = .11. Hypotheses 3.8 and 3.9 were not supported.

Computer Use and Efficacy

3.11 Among the subjects who exhibit high computer efficacy, the subjects who read PH will show higher levels of comfort with presentation style than those who read ST.

There was no significant computer efficacy effect, F (2, 201) = .6, p = .5. Regardless of participants' computer efficacy, those who read PH exhibited higher levels of comfort with presentation style than those who read ST.

3.12 Among the subjects who have low computer use and efficacy, the subjects who read EH will exhibit higher levels of comfort with presentation style than those who read PH.

This hypothesis was not supported. Among the participants who have low computer efficacy, the difference between those who read EH and PH was not statistically significant, t (44) = -1.02, p = .16, with an opposite direction from the anticipation.

Hypertext Familiarity and Knowledge

3.13 Among the subjects who have higher levels of hypertext familiarity and knowledge, those who read PH or EH will exhibit higher levels of comfort with presentation style than those who read ST.

A GLM model was used to test whether computer text formats (scrolling text, expanding hypertext, and paged hypertext) interacted with subjects' hypertext familiarity and knowledge to affect participants' level of comfort while reading the articles.

A significant interaction between the text formats and the levels of hypertext familiarity and knowledge was shown, F (2, 201) = 2.35, p < .05. Among those who were low in hypertext familiarity and knowledge, there was no significant difference

among three different hypertext types. In fact, the means were almost identical (ST; $\underline{M}$ = 74 and $\underline{SD}$ =19.8; EH; $\underline{M}$ =79, $\underline{SD}$ =17.0; and PH; $\underline{M}$=76.3, $\underline{SD}$ = 20.8) (Table 6). However, among those who were in the medium range, there was a significant difference between ST and PH in that those who read PH reported higher levels of comfort with presentation style than those who read ST, $\underline{t}$ (43) = -2.4, $\underline{p} < .01$. Furthermore, this difference became more prominent among those who have a higher level of hypertext familiarity and knowledge, $\underline{F}$ (2, 65) = 10.25, $\underline{p} < .001$. The significant differences existed between PH and ST as well as EH and ST (see Figure 14). Therefore, the hypothesis 3.12 was supported.

Table 6. Mean scores of comfort with presentation style by text format and hypertext familiarity and knowledge

	Comfort with Presentation Style Hypertext Familiarity Knowledge		
	Low	Medium	High
Scrolling Text	77 (22)	67 (20)	63 (20)
Expanding Hypertext	79 (16)	74 (22)	81(20)
Paged Hypertext	79(21)	84 (15)	88(19)

The numbers represent the mean scores in comfort with presentation style and standardized deviation scores in the parentheses.

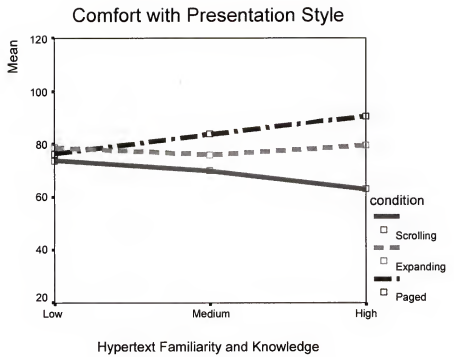

Figure 14. Text formats by hypertext familiarity and knowledge

Content Familiarity (Domain Knowledge)

3.14 When reading PH, those who are not familiar with the content will be less comfortable with presentation style than those who are familiar with the content.

There was a significant content familiarity effect, $\underline{F}$ (2, 65) = 4.8, $\underline{p} < .01$, and further analysis revealed that the significant differences were found between those who are low in content familiarity and those who are in the medium or high content familiarity range (Figure 15). Those who were not familiar with the content reported the lower scores in comfort with the presentation style ($\underline{M}$= 74, $\underline{SD}$ = 16.5) than the other two groups (EH; $\underline{M}$ = 84.3 and $\underline{SD}$ = 18.78 and PH; $\underline{M}$ = 91.6 and $\underline{SD}$ = 17.9). Therefore, this hypothesis was supported.

3.15 Among those who are not familiar with the content, those who read ST will exhibit higher levels of comfort with presentation style than those who read PH.

This hypothesis was not supported. In fact, a significant text format effect was found between those who read ST and EH, $\underline{t}$ (48) = -2.2, $\underline{p} < .02$. Those who read EH reported higher level of comfort with presentation style ($\underline{M}$ = 79, $\underline{SD}$ = 21) than those who read ST ($\underline{M}$ = 65, $\underline{SD}$ = 22).

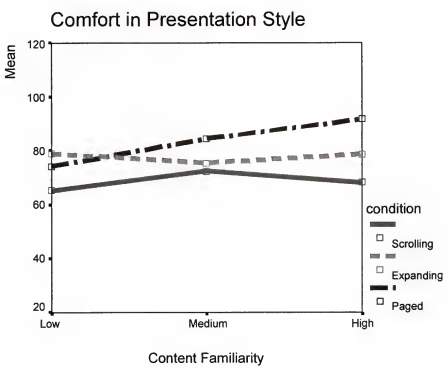

Figure 15. Text formats by content familiarity on comfort with presentation style

Gender

3.16 The female subjects who read ST or EH will exhibit higher levels of comfort with the presentation style than those who read PH.

This hypothesis was not supported, t (65) = 2.1, p = .15. Regardless of the participants' gender, those who read PH exhibited higher levels of comfort with the presentation style than those who read ST.

3.17 The male subjects who read PH will exhibit higher levels of comfort with presentation style than females.

This hypothesis was not supported, t (54) = .87, p = .20.

Hypotheses about Recognition as a Function of Learning

There was no significant text format main effect on the subjects' recognition scores, F (2, 201) = 1.4, p < .26.

Working Memory Capacity

4.1 Of the participants who are low in working memory capacity, the subjects who read ST will have higher recognition scores than those who read PH.

4.2 Among those who are low in working memory capacity, the subjects who read EH will have higher recognition scores than those who read PH.

There was a significant working memory capacity effect, F (2, 201) = 4.5, p < .01, and no significant text format effect, F (2, 201) = 2.46, p < .09, on participants' recognition performance. Hypothesis 4.1 was supported, F (2, 54) = 2.9, p < .05. Among those who were low in working memory capacity, those who read ST produced higher recognition scores (M = 24, SD = 8.1) than those who read PH (M = 19.7, SD = 6.9) (Table 7). However, hypothesis 4.2 was not supported. Furthermore, among the participants who had higher working memory span, there was no significant text format effect on the participants' recognition scores, F (2, 49) = .9, p < .41 (Figure 16).

Table 7. Mean scores of recognition scores by text format and working memory span

	Recognition		
	Working Memory Span		
	Low	Medium	High
Scrolling Text	24(8)	23 (7)	26 (7)
Expanding Hypertext	19(6)	23 (7)	24 (4)
Paged Hypertext	20(7)	24 (6)	23 (6)

The numbers represent the mean scores of recognition and standardized deviation scores in the parentheses.

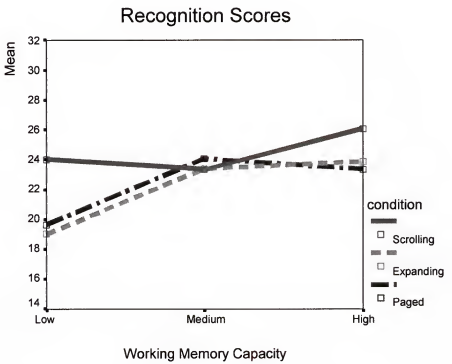

Figure 16. Text formats by working memory on recognition

Sensation-seeking Tendency

4.3 Among sensation seekers, the subjects who read EH will have higher recognition scores than those who read PH.

4.4 Among sensation seekers, the subjects who read PH will have higher recognition scores than those who read ST.

4.5 Among those who are not sensation seekers, the subjects who read PH will have lower recognition scores than those who read EH or ST.

There was no significant text format effect, F (2, 201) = 1.18, p = .30, or adventurousness effect, F (2, 201) = .24, p = .79, on participants' recognition performance. Therefore, hypotheses 4.3, 4.4, and 4.5 were not supported.

Need for Cognition

4.6 Among the subjects who are low in need for cognition, those who read PH will have lower recognition scores than those who read ST, but those who are high in need for cognition will not show the same effect.

There was no significant interaction effect, F (2, 4) = .22, p = .90, but a near significant need for cognition effect, F (2, 201) = 2.87, p < .06, on participants' recognition performance. Those who were high in need for cognition had higher recognition scores (M = 24.6, SD = 6.7) than those who were low in need for cognition (M = 21.9, SD = 5.7) regardless of the text formats.

Uncertainty Orientation

4.7 Among the subjects who are low in uncertainty orientation, those who read PH will show lower recognition scores than those who read ST.

An independent samples T-test was conducted to test this hypothesis. It was not supported, t (45) =.82, p = .22.

4.8 Among the subjects who are low in uncertainty orientation, those who read EH will have lower recognition scores than those who read ST.

The hypothesis 4.8 was not supported, t (45) = .68, p = .5.

Computer Use and Efficacy

4.9 Among the subjects who exhibit low computer use and efficacy, those who read ST will have higher recognition scores than those who read PH, but for those who are high in computer use and efficacy, those who read PH will show higher scores than those who read ST.

4.10 Among the subjects who are low in computer use and efficacy, the subjects who read EH will exhibit higher recognition scores than those who read PH.

A GLM model was used to test whether computer text formats (scrolling text, expanding hypertext, and paged hypertext) interacted with subjects' computer efficacy to affect participants' recognition scores.

There was a significant interaction between text formats and levels of computer efficacy on participants' recognition performance, $\underline{F}$ (4, 201) = 2.7, $\underline{p} < .03$. Further analysis revealed that among those who were low in computer use and efficacy, a significant difference was found among those who read ST and those who read EH. The subjects who read EH ($\underline{M}$ = 20, $\underline{SD}$ = 5.6) showed lower recognition scores than those who read ST ($\underline{M}$ = 24, $\underline{SD}$=5.8) or PH ($\underline{M}$ = 23, $\underline{SD}$ = 7.5) (Table 8). However, among those who were high in computer efficacy, those who read ST ($\underline{M}$ = 26.9, $\underline{SD}$ =7.6) had higher recognition scores than those who read either EH ($\underline{M}$ = 22.4, $\underline{SD}$ = 6.1) or PH ($\underline{M}$ = 22.4, $\underline{SD}$ = 6.1). Therefore, the hypothesis 4.9 and 4.10 were not supported. In fact, the results came out in an opposite direction the participants who read EH exhibited lower recognition scores than those who read PH for those who are low in computer use and efficacy (Figure 17).

Table 8. Mean scores of recognition scores by text format and computer use and efficacy

	Recognition		
	Computer Use and Efficacy		
	Low	Medium	High
Scrolling Text	24(6)	21(7)	27 (8)
Expanding Hypertext	20(6)	24 (6)	22 (6)
Paged Hypertext	23(8)	22 (6)	22 (6)

The numbers represent the mean scores of recognition and standardized deviation scores in the parentheses.

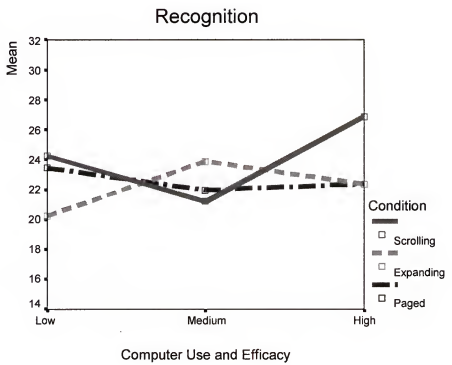

Figure 17. Text formats by computer use and efficacy on recognition

Hypertext Familiarity and Knowledge

4.11 Among the subjects who have low levels of hypertext familiarity and knowledge, those who read ST will have higher recognition scores than those who read PH or EH.

This hypothesis was not supported, F (2, 66) = 1.3, p = .27, even though there was a significant main hypertext familiarity and knowledge effect on subjects' recognition scores, F (2, 201) = 3.7, p < .03.

Content Familiarity (Domain Knowledge)

4.12 Among those who are low in content familiarity, those who read the PH will have lower recognition scores than those who read ST, but among those who are high in content familiarity the same effect will not show.

4.13 For those who are low in content familiarity, those who read EH will exhibit higher recognition scores than those who read PH.

There was a significant interaction between the levels of content familiarity and text formats, F (4, 201) = 2.7, p < .04. Further analysis revealed that the difference was shown among those who were high in content familiarity in that those who read EH (M = 20.2, SD = 5.3) exhibited the lower recognition scores than those who read ST (M = 26, SD = 6.8) or PH (M = 25.3, SD = 5.7) (Table 9). However, for those who were low or medium in content familiarity, there was no significant text format effect on participants' recognition scores (Figure 18).

Table 9. Means of recognition by text format and content familiarity on recognition

	Recognition		
	Content Familiarity		
	Low	Medium	High
Scrolling Text	22 (8)	23(7)	26 (7)
Expanding Hypertext	23 (6)	24 (6)	20 (5)
Paged Hypertext	21 (5)	22 (5)	25 (6)

The numbers represent the mean scores in liking of presentation style and standardized deviation scores in the parentheses.

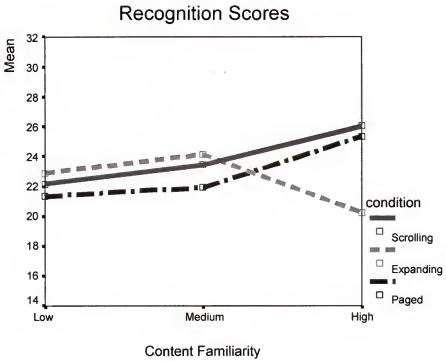

Figure 18. Text formats by content familiarity on recognition

Gender

1.14 Of the male participants, those who read PH will produce higher recognition scores than the female participants.

This hypothesis was not supported, $\underline{t}$ (65) = -.53, $\underline{p}$ = .30.

In this study, for descriptive analysis, the effects of the text formats and other independent variables were tested on how much time the participants spent reading the texts. Several interesting findings were noted in terms of the text formats, $\underline{F}$ (2, 201) = 3.3, $p < .04$, need for cognition, $\underline{F}$ (2, 201) = 5.3, $p < .003$, and uncertainty orientation, $\underline{F}$ (2, 201) = 4.35, $\underline{p} < .01$.

The findings were as follows: The participants who read the scrolling text read the texts (M = 591 sec., SD = 332.3 sec.) longer than those who read the paged hypertext (M = 456 sec., SD=317 sec.) or the expanding hypertext (M = 509 sec., SD = 320 sec.). Furthermore, regardless of the text formats, the higher participants were in need for cognition or uncertainty orientation, the longer the participants spent reading the texts.

Based on these findings, the near significant text format effect shown with working memory capacity on recognition was reexamined with total reading time as a covariate. Working memory capacity remained significant, F (2,201) = 3.48, p < .03, and total reading time was shown as a significant factor predicting the participants' recognition scores, F (1,201) = 112.8, $p \leq .01$. However the text format effect was shown as insignificant, F (2,201) = .8, p < .50.

Gender was also compared with other independent variables. The significant gender effects were found on need for cognition, t (201) = 2.8, p < .003, uncertainty orientation, t (201) = 2.0, p < .02, computer use and efficacy, t (201) = 1.7, p < .05, and hypertext familiarity and knowledge, t (201) = 2.5, p < .01. In general, male participants produced higher scores than the female participants on need for cognition, uncertainty orientation, computer use and efficacy and hypertext familiarity and knowledge.

CHAPTER 6
SUMMARY AND CONCLUSIONS

Summary

The factors that affected participants' liking of the presentation style were different text formats and adventurousness. Highly adventurous participants tended to like the paged hypertext more than the scrolling text as expected. However, the liking scores for the expanding hypertext fell in between the others, and the results were suggestive, but not conclusive. The same pattern was found among those who were low in adventurousness. On the other hand, those who were medium in terms of their adventurousness liked the expanding hypertext style best.

The factors that affected disorientation were adventurousness, hypertext familiarity and knowledge, content familiarity, and gender. For those who were not adventurous, expanding hypertext created the most disorientation. Of the participants who were in the medium range, those who read the expanding hypertext reported the least disorientation while those who read the paged hypertext reported the most disorientation. Interestingly, for the participants who were highly adventurous, the scrolling text was identified as the most disorienting or frustrating text format while the paged one was reported as the least disorienting. As anticipated, those who had higher scores in hypertext familiarity and knowledge and content familiarity considered the paged hypertext less disorienting than those who had lower scores in hypertext familiarity

and knowledge and content familiarity. The content familiarity effect was shown consistently regardless of the different text formats as expected. In addition, among the participants who read PH, the female subjects exhibited higher scores in disorientation than the male subjects did.

The identified factors that affected the participants' level of comfort with the presentation style were different text formats, adventurousness, hypertext familiarity and knowledge, and content familiarity. Regarding the text formats, the participants who read the paged hypertexts reported the highest level of comfort with reading the articles while the participants who read the scrolling texts reported the least level of comfort. The participants who read the expanding hypertexts fell in between. Moreover, regardless of the text format, adventurous participants reported higher levels of comfort with the presentation style than those who are not adventurous. A significant interaction was found between participants' level of hypertext familiarity and knowledge and the text formats. For those who were low in hypertext familiarity and knowledge, there was no significant difference among the three different hypertext types. However, for those who were in the medium range, those who read the paged hypertext reported higher levels of comfort with presentation style than those who read the scrolling text, and this difference became evident for those who were categorized as the highest level of hypertext familiarity and knowledge. Last, the participants' content familiarity (domain knowledge) was shown to affect the level of comfort that the participants experienced. For those who were not familiar with the content, those who read the expanding hypertext or the paged hypertext reported a higher level of comfort than those who read the scrolling text. This difference became more pronounced among those who had a

higher level of content knowledge. The significant differences existed at all three levels in the order of paged hypertext as the most comfortable format, followed by expanding hypertext, and then scrolling text as the least comfortable format.

As a function of learning, the participants' recognition scores were measured and tested in relation to other independent variables. Six factors were identified in this study; working memory capacity, need for cognition, uncertainty orientation, and computer use and efficacy, hypertext familiarity and knowledge, and content familiarity (domain knowledge). As anticipated, for those who were low in working memory capacity, the scrolling text produced higher recognition scores than the paged hypertext or the expanding hypertext, while this difference disappeared among the participants who had higher working memory spans. Regardless of text format, those who were high in need for cognition showed higher recognition scores than those who were low in need for cognition. Also, it was found that those who were not uncertainty oriented had higher recognition scores when reading from the scrolling text than those who read the expanding hypertext. Unexpectedly, it was found that for those who had higher scores in computer use and efficacy, reading the texts from either expanding or paged hypertexts produced better results than did the scrolling text. The results were opposite for those who had lower scores in computer use and efficacy; those who read the scrolling text produced lower recognition scores than those who read the expanding or paged hypertext. Moreover, the participants who were low in hypertext familiarity and knowledge produced higher recognition scores when reading from the scrolling text than those who read the expanding hypertext. One interesting finding pertains to participants' content familiarity: Reading from the expanding hypertext produced lower recognition scores

among those who were high in content familiarity, even though for those who were low or medium in content familiarity, there was no significant text format effect on participants' recognition scores. In addition, the result revealed an opposite direction from the original anticipation in that the male participants who read the scrolling text had higher recognition scores than those who read the paged or expanding hypertexts.

Conclusions

The study results indicate that both different styles of information presentation and the working memory capacities of different individuals influence how well information is recognized. Many scholars have suggested that hypertext systems tend to overload cognitive processing capabilities and encourage over-simplification of information read. However, these speculations may be premature since further research needs to be conducted on individual characteristics such as working memory span and sensation-seeking tendencies.

Furthermore, the additional findings in this study suggest that time (how much time each individual spends reading the given information) seems to be an important mediating factor that influences how much information is learned rather than cognitive overload or disorientation. In other words, different types of information presentation styles seem to influence how long individuals read the given information, and in turn, the time spent reading influences how much information was remembered.

Considering individual differences in working memory span as applied to the reading of hypertext learning materials, the findings in this research may give clues for practical applications. For those who are low in working memory capacity, linear information presentation seems most beneficial.

In general, PH and EH produced higher scores in terms of liking of presentation style than did ST. Particularly, the participants' sensation seeking tendencies were shown as an important factor influencing their liking of specific presentation styles, disorientation, and comfort in presentation styles. In general, highly adventurous people tend to like PH or EH over ST and considered ST as the most disorienting or frustrating format. EH was shown to be in the middle.

One interesting finding was that hypertext familiarity and knowledge exhibited several interactions with the text formats on the subjects' disorientation and comfort in presentation style. Among those who were low in HFK, the PH was considered most disorienting while the expanding was the least disorienting. In terms of comfort with a presentation style, the difference among the three different text formats were not significant. However, of the participants who were high in HFK, the PH was considered the least disorienting and most comfortable while the ST was considered the most disorienting or frustrating style and the least comfortable style. This might be because readers with high familiarity and knowledge of hypertext have more previous experience in hypertext learning materials. However, it was not expected to find that those who are high in HFK actually feel disorientation or frustration when they read the plain scrolling text. Further research is necessary to find out whether this is the case and what is really going on in terms of hypertext familiarity and knowledge and different text formats.

There were several near significant effects that call for further investigation with more reliable and precise measurements. For future studies, some of the measurements should be refined. For example, the reliability of the hypertext familiarity and knowledge scale was low at the level of the Cronbach's alpha .66. Considering the fact that several

significant findings were shown in this study regarding to this construct, further refinement is necessary.

Although gender was a significant factor on computer use and efficacy, not much research has been conducted in this area in terms of actual learning. In the study, comparisons between male and female subjects' scores showed two interesting trends: Female participants considered PH more disorienting or frustrating than the male counterparts. Furthermore, female participants' recognition scores did not vary much with the different text formats while the male subjects' scores varied. However, the results came out in the opposite direction for those who read ST--the male subjects' recognition scores were higher than the female subjects' scores. Considering gender differences found with other independent variables such as computer use and efficacy, hypertext familiarity and knowledge, need for cognition, and uncertainty orientation, identified differences need to be further analyzed to see what relationships hold among those factors.

This study had several limitations that should be considered for interpretation of the results and suggestions of further studies. First of all, since the subjects were college students who tend to exhibit a high sensation seeking tendency, enough variation might have not shown. In turn, this might have been why some of hypothesis tests exhibited low levels of power and not enough evidence to reject the null hypotheses. This needs to be examined in future studies with more varied participants such as high school students and post graduate students, for example. In addition, it should be noted that for the purpose of hypothesis testings, the participants' cognitive and behavioral characteristics

were artificially categorized into three subgroups: low, medium, and high. This should not be considered as natural divisions of a general population.

Moreover, the small sample size of the male participants makes it difficult to note possible gender differences that might have existed. Therefore, a careful interpretation should be applied to the results of this experiment pertaining to gender. Further research is required with more subjects for more accurate results.

Second, the findings should be interpreted in proper context as they apply to the real world. The manipulation of stimulus (text formats) are not necessarily as they would be found in the field in that the scrolling and paged text were supposed to simulate what was most commonly found in both computer application help systems and web pages. The links within these three documents lead directly to other excerpts of the same document as where those on the Internet, for example, might lead to entirely unrelated content. However, since this study is focused on applications for learning, it was presumed that content should be focused for instructional purposes.

Third, the study setting, as anticipated in an experimental study, should be carefully readdressed. For the purpose of this study, the subjects were located in a computer lab and asked to try to explore all the links before they clicked the finished button. It was not intended to simulate a naturalistic setting such as casually surfing the Internet at home. It was focused on instructional settings where certain learning purposes would be intentionally presented such as in a lab instructional setting. For designing effective, tailored, independent study materials for learning, participants' learning styles and behaviors when studying alone should be explored.

There were several findings worth noting in terms of the newly proposed hypertext, expanding hypertext. As expected, the findings suggested that expanding hypertext can be used as an alternative for paged hypertext. In general, the participants liked expanding hypertext better than the scrolling text. Furthermore, of the participants who were categorized as medium in terms of adventurousness, the expanding hypertext was considered the least disorienting while those who read the PH reported the most disorientation. However, the expanding hypertext exhibited a possible disadvantage in that among those who considered themselves familiar with the content, EH produced the lowest recognition scores. This phenomenon might be explained by the notion that those who considered themselves familiar with the content tend to skip information that underlies hyperlinks, mistakenly assuming they already know the content. Furthermore, since expanding hypertext is an innovative technology, many of the participants expressed unfamiliarity with it. This might have affected the present findings in that the participants' unfamiliarity of the system might explain why most hypotheses pertaining to expanding hypertext did not result as anticipated. The participants' lack of experience with the expanding hypertext makes it difficult to compare with the more familiar ST and PH styles. This avenue needs further scientific investigation.

Hypertext is assumed to provide selective attention and learner control over his or her own learning materials. Many educators believe that selective attention determines which information is processed or ignored, thereby accelerating information processing by driving straight to the most needed aspects of the materials. On the other hand, learner control and selective exposure of certain information might also create fragmented information processing and end up producing poorer learning. It is worth examining

"selective attention" in terms of hypertext use more closely to evaluate its implications for the future. Areas to consider include learning of all presented information and learning of information that is of interest to subjects. Hypertext functions by allowing students to follow their train of thought and to click on the links that interest them. This might not be a good option for those who are not quite as familiar with the content or who have little experience with the system given.

Disorientation has been the most frequently cited hypertext problem. However, in this study, it appears not to be cognitive disorientation, but rather how much time was spent processing the given information. It seems that computer text formats influence how much time each individual spends on each text, which in turn influences how much information is learned. This, of course, hints at a fragmented knowledge effect.

It is also suspected that the types of content may have an influence. It was noticed to a certain degree that the content of an article dictates the design of learning materials. The content of learning materials tends to contain logical breaking points that determine where hyperlinks can exist, pointing from excerpt to excerpt or between related documents. One example of this is the Introduction, Body, and Conclusion of a text. If this is the case, breaking the natural presentation order might cause disorientation and in turn result in poorer learning. This implies that educators and instrument designers should carefully select the format of the information they give their students or subjects. It may have an effect on how well the given information gets processed.

Understanding the characteristics of individuals within target audiences such as sensation-seeking tendencies, need for cognition, and uncertainty orientation will help us design effective messages for getting their attention and for further information

processing. Furthermore, understanding their cognitive abilities will further empower us to accommodate individuals' different abilities and preferences. Designing effective learning materials should be based on tailoring to these differences, and identifying them in the context of hypertext learning as the first step toward optimizing their learning experiences.

The findings of this study can be utilized in practical settings. One example is for designing effective learning materials on the Internet. For those who are adventurous, it seems more beneficial to use different types of hypertexts than the scrolling text. It can be used to get their initial attention by accommodating their need for stimulus. Furthermore, learning materials should be designed in a way that accommodates the cognitive capacities of individuals as well as their personality traits in terms of their preferences and needs.

Understanding the complex relationships among the abilities of individuals, their needs, and their experiences as well as the nature of learning in hypertext environments is like solving a deeply interwoven puzzle. Addressing individual differences is no longer just optional, but it is necessary. This research began by recognizing individual differences in learning from different types of computer text formats. The fundamental idea that ran through all the assumptions was that now we are no longer bound to create or find only one best learning material for everyone. The notion of tailored communication calls for a new perspective, not only on how we design educational materials but also on how we investigate human phenomenon through scientific inquiry. Individual differences in communication have been noted long before the advent of new communication technologies and studied vigorously as a part of human communication

studies. However, practical applications of these differences were never fully utilized beyond the scope of interpersonal communication due to the nature of broadcast medium. Now, new communication technologies, such as that found in modern computer software, open a new door to reconsider how we communicate with each other through what were formerly considered broadcast mediums. Multicasting and interactively tailored content and presentation formats will optimize the human learning experience and further open doors for enriched human scientific inquires.

APPENDIX
THREE ARTICLES AND RECOGNITION TESTS

How much do you know about the history of Central America? (CA)

As early as 7000 B.C., Central Americans founded farming cultures which eventually developed into the complex civilizations of the Olmec, Toltec, Aztec and Maya. Let's find out more about Central America.

CUBA
Approximately 50,000 Indians lived in Cuba when Columbus reached Cuba in 1492. Its name derives from the Indian Cubanacan. Except for British occupation of Havana, 1762-63, Cuba remained Spanish until 1898.

A slave-based sugar plantation economy developed from the 18th century, aided by early mechanization of milling. Sugar remains the chief product and export despite government attempts to diversify.

After the Spanish-American War, Spain gave up all claims to Cuba. U.S. troops withdrew in 1902. In 1952, former Pres. Fulgencio Batista established a harsh and corrupt dictatorship. Fidel Castro and a band of rebels overthrew this government in 1959. In 1961, 1,400 Cubans, trained and backed by the U.S. Central Intelligence Agency, unsuccessfully tried to invade and overthrow the regime. In 1962, the U.S. learned that the USSR had brought nuclear missiles to Cuba. After an Oct. 22 warning from Pres. John F. Kennedy, the missiles were removed.

Cuba resisted the social and economic reforms that took place in the late 1980s and 1990s in the Soviet Union and its successor states and in Eastern Europe. Cuba's economy, formerly propped up by preferential trading status within the communist bloc, was severely shaken by the fall of the communist block. Stiffer trading sanctions enacted by the U.S. in 1992 made things worse.

GUATEMALA
It is in what we now know as Guatemala that the old Mayan Indian empire flourished for over 1,000 years before the Spanish. Guatemala was a Spanish colony 1524-1821; briefly a part of Mexico and then of the U.S. of Central America. The republic of Guatemala was established in 1839.

Since 1945 when a liberal government was elected to replace the long-term dictatorship of Jorge Ubico, the country has seen a variety of military and civilian governments and periods of civil unrest. Dissident army officers seized power Mar. 23, 1982, denouncing a presidential election as fraudulent and pledging to restore "authentic democracy" to the nation. Political violence caused large numbers of Guatemalans to seek refuge in Mexico. Another military coup occurred Oct. 8, 1983. The nation returned to civilian rule in 1986.

The crisis-ridden government of Pres. Jorge Serrano Elias was ousted by the military June 1, 1993. Ramiro de Leon Carpio was elected president by Congress June 6. Limited electoral reforms have come about since 1994.

EL SALVADOR
El Salvador became independent of Spain in 1821 and of the Central American Federation in 1839.

In 1979, a military coup overthrew the government of President Romero. However, the ruling military-civilian Junta failed to quell a rebellion by leftist insurgents, armed by Cuba and Nicaragua. Extreme right-wing death squads organized to eliminate suspected leftists were blamed for thousands of deaths in the 1980s. The US government staunchly supported the El Salvadoran government with military aid.

Citizens of EL Salvador turned out in large numbers in the May 1984 presidential election. Christian Democrat Duarte was then elected president with 54 percent of the vote.

Under Duarte's rule a vicious civil war raged, and in 1990 nine soldiers were indicted for the 1989 slaying of six Jesuit priests. The 12-year civil war ended in 1992 with the signing of a formal peace treaty, which provided for political reforms.

NICARAGUA
Nicaragua, inhabited by various Indian tribes, was conquered by Spain in 1552. After gaining independence from Spain, 1821, Nicaragua was united for a short period with Mexico, then with the United Provinces of Central America, finally becoming an independent republic in 1838.

Nicaraguan President Debayle imposed martial law in 1974, after officials were kidnapped by the Marxist Sandinista guerrillas. This action led to nationwide strikes against the government and touched off a civil war. Months of simmering civil war ended when Somoza fled, July 19, 1979.

Relations between the U.S. and Nicaragua have often been less than friendly with the United States intervening militarily several times in the two countries' histories. The Last American military occupation of Nicaragua was from 1926 to1933. More recently, relations became strained when Nicaragua backed leftist guerrillas in El Salvador while the U.S. backed the Anti-Sandinista contra guerrilla groups.

In 1983, the contras launched their first major offensive; the Sandinistas imposed rule by decree. In 1985, the U.S. House rejected Pres. Reagan's request for military aid to the contras. The subsequent diversion of funds to the contras from the proceeds of a secret arms sales to Iran caused a major scandal in the U.S. In a stunning upset, Violeta Barrios de Chamorro defeated Ortega in national elections, Feb. 25, 1990. Ortega remained leader of the Sandinista party.

MEXICO
Mexico was the site of advanced Indian civilizations. The Mayas, an agricultural people moved up from Yucatan, built immense stone pyramids, invented a calendar. The Toltecs were overcome by the Aztecs, who founded Tenochtitlan 1325 AD, now Mexico city. Hemando Cortes, Spanish conquitador, destroyed the Aztec empire, 1519-1521.

After 3 centuries of Spanish rule the people rose, under Fr. Miguel Hidalgo Y Costilla, 1810, Fr. Morelos Y Payon, 1812, Agustin I, 1821. Maxico bacame a republic in 1823. French arms supported an Austrian archduke on the throne of Mexico as Maximilian I, 1864-67, but pressure from the U.S. forced France to withdraw. Political unrest continued until a new constitution was adopted in 1917. Since that time, Mexico has developed large-scale programs of social security, labor protection, and school improvement.

Despite this country's discovery of vast oil reserves, much of Mexico's work force is still jobless and underemployed. On Jan. 1, 1994 the Zapatista guerilla movement launched in southern Mexico.

A tentative peace accord was reached Mar. 2.

Questions about the History of Central America

Please click your answers on the screen:
Choose only one answer based on information in the article.

1. How was the civil war in El Salvador concluded?
   - ○ The leftist rebels defeated the government.
   - ○ The government defeated the rebels.
   - ○ Fighting still persists.
   - ○ The two sides signed a peace treaty.
   - ○ There never was a civil war.

2. Guatemala was a colony of...
   - ○ France
   - ○ Lima
   - ○ Spain

- Portugal
- Turkey

3. Upon the collapse of the communist bloc, how did U.S. policy change toward Cuba?
   - Stiffer trading sanctions were enacted.
   - Sanctions were eased slightly.
   - Diplomatic relations were restored.
   - Diplomatic relations were severed.
   - No change.

4. In El Salvador, what crime were nine soldiers indicted for in January 1990?
   - Accepting bribes from the United Brands Co.
   - Selling arms to an American company.
   - Murder of six Jesuit priests.
   - Treason for a coup attempt.
   - Organization of Death Squads to kill political opponents.

5. What happened in Nicaragua in 1983?
   - The president was assassinated.
   - Nationwide strikes touched off a state of civil war.
   - Nothing. It was a peaceful year.
   - The Contras launched their first major offensive.
   - Ron Howard filmed "The El Paso Kid."

6. When did the Zapatista National Liberation Army launch an uprising in Mexico?
   - 1904.
   - 1994.
   - 1768.
   - 1986.
   - 1964.

7. When was the last time U.S. Marines occupied Nicaragua?
   - From 1926 to 1933.
   - American Marines have never occupied Nicaragua.
   - From 1967 to 1972.
   - U.S. Marines currently occupy Nicaragua.
   - From 1821 to 1838.

8. When did El Salvador become independent of Spain?
   - 1512
   - 1821
   - 1700
   - 1689
   - 1969

9. What is the chief product and chief export of Cuba?
   - Pepsi.
   - Timber.
   - Sugar.
   - Coffee.
   - Tobacco.

10. Who was Fulgencio Batista?
   - Leader of a Mexican rebellion.
   - Leader of a Cuban rebellion.
   - Dictator of El Salvador.
   - Dictator of Cuba.
   - Singer for a Latino band.

11. According to the text, Mexico has which of the following natural resources?
    - Ice cubes.
    - Oil.
    - Timber.
    - Salt.
    - Coffee.

12. When was the Guatemalan Republic established?
    - 1839
    - 1700
    - 1994
    - 1970
    - 1995

13. Who did the US back in the Nicaraguan civil war?
    - Sandinistas
    - anti-Sandinistas/contras
    - Mayans
    - Castro
    - Conquistadors

14. Where did the Guatemalans who fled from this country emigrate to?
    - US
    - Cuba
    - Mexico
    - Spain
    - all of the above

15. In Mexico, the Toltecs were conquered by:
    - Aztecs.
    - Cortez.
    - Sandinistas.
    - Hernando Desoto.
    - Batista

16. Why were U.S.-Nicaraguan relations strained?
    - Nicaragua seized U.S. assets in Nicaragua.
    - Nicaragua became communist.
    - Nicaragua banned American goods.
    - Nicaragua sent military aid to leftist guerrillas in ElSalvador.
    - No reason

The battle against segregation in America (AA)

During the 1930's National Association for the Advancement of Colored People (NAACP) attorneys Charles H. Houston, William Hastie, James M. Nabrit, Leon Ransom, and Thurgood Marshall charted a legal strategy designed to end segregation in education. They developed a series of legal cases challenging segregation in graduate and professional schools. Houston believed that the battle against segregation had to begin at the highest academic level in order to mitigate fear of race mixing that could create even greater hostility and reluctance on the part of white judges.

After establishing a series of favorable legal precedents in higher education, NAACP attorneys planned to launch an all-out attack on the separate-but-equal doctrine in primary and secondary schools. The strategy proved successful. In four major United States Supreme Court decisions precedents were established that would enable the NAACP to construct a solid legal foundation upon which the Brown case could rest : Missouri ex rel. Gaines v. Canada, Registrar of the University of Missouri (1938); Sipuel v. Board of Regents of the University of Oklahoma (1948); McLaurin v. Oklahoma State Regents for Higher Education (1950); and Sweatt v. Painter (1950).

In the Oklahoma case, the Supreme Court held that the plaintiff was entitled to enroll in the University. The Oklahoma Regents responded by separating black and white students in cafeterias and classrooms. The 1950 McLaurin decision ruled that such internal separation was unconstitutional. In the Sweatt ruling, delivered on the same day, the Supreme Court held that the maintenance of separate law schools for whites and blacks was unconstitutional. A year after Herman Sweatt entered the University of Texas law school, desegregation cases were filed in the states of Kansas, South Carolina, Virginia, and Delaware, and in the District of Columbia asking the courts to apply the qualitative test of the Sweatt case to the elementary and secondary schools and to declare the separate-but-equal doctrine invalid in the area of public education.

The 1954 Brown v. Board of Education decision declared that a classification based solely on race violated the 14th Amendment to the United States Constitution. The decision reversed the 1896 Plessy v. Ferguson ruling which had established the separate-but-equal doctrine. The Brown decision more than any other case launched the "equalitarian revolution" in American jurisprudence and signaled the emerging primacy of equality as a guide to constitutional decisions; nevertheless, the decision did not end

state sanctioned segregation. Indeed, the second Brown decision, known as Brown II and delivered a year later, played a decisive role in limiting the effectiveness and impact of the 1954 case by providing southern states with the opportunity to delay the implementation of desegregation.

The intervention of the federal government and the deployment of the National Guard in the 1954 Little Rock crisis, and again in 1963 when the enrollment of James Meredith desegregated the University of Mississippi, highlights the role of federal power in promoting social change during this era. While black local and national leaders organized and orchestrated the legal struggles, and students joined in freedom rides and staged sit-ins, another equally important dimension of the rights quest took shape : the battle between federal and state authority and the evolution of the doctrine of federalism. The fact remains that the United States Supreme Court lacked the power to enforce its decision. President Dwight D. Eisenhower's use of federal troops in Little Rock was a major departure from the reluctance of past presidents to display federal power in the South, especially to protect the lives and rights of black citizens.

Questions for the Battle against Segregation in America

Please click your answers on the screen:
Choose only one answer based on information in the article.

1. In the article, the struggle for desegregation in the South also caused...
   - ○ white student protests and petitioning
   - ○ a struggle between state and federal authority
   - ○ the evolution of the doctrine of confederalism
   - ○ a struggle between state police and federal troops

2. What does the NAACP stand for ?
   - ○ National Activists for American Colored People
   - ○ Negro Activists for the Advancement of Colored People
   - ○ National Association for the Advancement of Colored People
   - ○ National Association for the American Colored People

3. According to the article, what case launched the "equalitarian revolution" in American jurisprudence?
   - ○ Brown v. Board of Education
   - ○ Sweatt v. Painter
   - ○ Plessy v. Ferguson
   - ○ McLaurin V. Oklahoma

4. In Little Rock case and at other southern universities, what did students do ?

- staged sit-ins and freedom rides
- held protests and signed petitions
- kept themselves away from any violence
- marched on capitol hill

5. A year after Herman Sweatt entered the University, segregation cases were filed in the states of....

- Kansas, South Carolina, Virginia, and New Mexico.
- Kansas, North Carolina, Virginia, and California.
- Kansas, South Carolina, Florida, and Delaware.
- Kansas, South Carolina, Virginia, and Delaware.

6. In the Oklahoma case, the Supreme Court held that the plaintiff was entitled to enroll in the University. The Oklahoma Regents responded by..

- separating black and white students in cafeterias and classrooms.
- creating the separate-but-equal clause.
- not allowing black students to attend primary and secondary schools.
- integrating black and white students in cafeterias and classrooms.

7. What court case occurred in 1950?

- Marshall v. Board of Regents of the University of Virginia
- Sweatt v. Painter
- Brown v. Board of Education
- Plessy v. Ferguson

8. The intervention of the federal government and the deployment of the National Guard occurred in the Little Rock crisis of ...

- 1990 and at the desegregation of the University of Mississippi.
- 1954 and the desegregation of the University of Alabama.
- 1800 and at the desegregation of the University of Louisiana.
- 1954 and the desegregation of the University of Mississippi.

9. According to one attorney s belief, the battle against segregation had to begin at the highest academic level to mitigate fear of race mixing that could....

- create even greater hostility and reluctance on the part of blacks.
- create even greater hostility and reluctance on the part of white judges.
- create even greater hostility and reluctance on the part of segregationists.
- create even greater hostility and reluctance on the part of the Supreme Court.

10. What was the role of Brown II?

- showing federal government power in the South.
- carrying out the 1954 case decision.
- signaling the emerging primacy of equality as a guide to constitutional decisions
- limiting the effectiveness and impact of the 1954 case.

11. The Brown v. Board of Education case declared what?

- classification based on race violated the 14th amendment
- classification based on race violated the 1st amendment
- classification based on race violated the constitution
- classification based on race did not violate the constitution

12. Who believed that the battle against segregation had to begin at the highest academic level?

- Dwight D. Eisenhower
- Herman Sweatt
- Charles H. Houston
- Leon Ransom

13. What school did Herman Sweatt enter?

- The University of Florida law school
- The University of Texas law school
- The Temple University
- The Harvard University law school

14. When was the Plessy v. Ferguson case held?

- in 1700
- in 1956

- in 1896
- in 1938

15. What was the 1950 McLaurin decision?
    - The external separation is constitutional.
    - The external separation is unconstitutional.
    - The discarding of separate law schools for whites and blacks is unconstitutional.
    - The internal separation is unconstitutional.

16. According to the last paragraph in the article, what "one fact" remains?
    - federal troops had never before been used to protect the rights of black citizens.
    - federal troops had never before been used to protect the lives of black citizens.
    - the United States Supreme Court lacked the power to enforce its decision.
    - the United States Supreme Court lacked the ability to make a sound decision.

Ethology vs. Behaviorism (PS)

The distinction often made between learning and instinct is exemplified by two theoretical approaches to the study of behavior: ethology and behaviorist psychology.

Ethology is usually thought of as the study of instinct. In the ethological world view most animal behavior is governed by four basic factors: sign stimuli (instinctively recognized cues), motor programs (innate responses to cues), drive (controlling motivational impulses) and imprinting (a restricted and seemingly aberrant form of learning).

Three of these factors are found in the egg-rolling response of geese, a behavior studied by Konrad Z. Lorenz and Nikolaas Tinbergen, who together with Karl Frisch were the founders of ethology.

Geese incubate their eggs in mound-shaped nests built on the ground, and it sometimes happens that the incubating goose inadvertently knocks an egg out of the nest. Such an event leads to a remarkable behavior. After settling down again on its nest, the goose eventually notices the errant egg. The animal then extends its neck to fix its eyes on the egg, rises and rolls the egg back into the nest gently with its bill. At first glance this might seem to be a thoughtful solution to a problem. As it happens, however, the behavior is highly stereotyped and innate. Any convex object, regardless of color and almost regardless of size, triggers the response; beer bottles are particularly effective.

In this example the convex features that trigger the behavior are the ethologists' sign stimuli. The egg-rolling response itself is the motor program. The entire behavior is controlled by a drive that appears about two weeks before the geese lay eggs and persists until about two weeks after the eggs hatch. Geese also exhibit imprinting; during a sensitive period soon after hatching, goslings will follow almost any receding object that emits an innately recognized "kum-kum" call and thereafter treat the object as a parent.

Classical behaviorist psychologists see the world quite differently from ethologists. Behaviorists are primarily interested in the study of learning under strictly controlled conditions and have traditionally treated instinct as irrelevant to learning. Behaviorists believe nearly all the responses of higher animals can be divided into two kinds of learning called classical conditioning and operant conditioning.

Classical conditioning was discovered in dogs by the Russian physiologist Ivan P. Pavlov. In his classic experiment he showed that if a bell is rung consistently just before food is offered to a dog, eventually the dog will learn to salivate at the sound of the bell.

The important factors in classical conditioning are the unconditioned stimulus (the innately recognized cue, equivalent to the ethological sign stimulus, which in this cases is food), the unconditioned response (the innately triggered behavioral act, equivalent to the ethological motor program, which in this case is salivation) and the conditioned stimulus (the stimulus the animal is conditioned to respond to, which in this case is the bell). Early behaviorists believed any stimulus an animal was capable of sensing could be linked, as a conditioned stimulus, to any unconditioned response.

In operant conditioning, the other major category of learning recognized by most behaviorists, animals learn a behavior pattern as the result of trial-and-error experimentation they undertake in order to obtain a reward or avoid a punishment. In the classic example a rat is trained to press a lever to obtain food. The experimenter shapes the behavior by rewarding the rat at first for even partial performance of the desired response. For example, at the outset the rat might be rewarded simply for facing the end of the cage in which the lever sits. Later the experimenter requires increasingly precise behavior, until the response is perfected. Early behaviorists thought any behavior an animal was capable of performing could be taught, by means of operant conditioning, as a response to any cue or situation.

Questions for Ethology vs. Behaviorism

Please click your answers on the screen:
Choose only one answer based on information in the article.

1. In the dog's example, the conditioned stimulus is...
   - ○ salivation
   - ○ bell

- food
- cue

2. Geese incubate their eggs in...
   - round-shaped nests
   - bell-shaped nests
   - mound-shaped nests
   - none of above

3. According to ethologists' view, the convex features that trigger the behavior, in the geese example, are...
   - motor programs
   - sign stimuli
   - imprinting
   - drive

4. How long does the egg-rolling behavior of geese persist?
   - two weeks
   - three weeks
   - four weeks
   - one week

5. Classical behaviorists are primarily interested in the study of _____ under strictly controlled conditions.
   - behaviors
   - learning
   - sign stimuli
   - experimentation

6. Who discovered classical conditioning?
   - Karl Frisch
   - David W. Griffith
   - Nikolaas Tinbergen
   - Ivan P. Pavlov

7. According to the article, early behaviorists thought any behavior an animal was capable of performing could be...

- explained
- taught
- rewarded
- changed

8. Geese's reaction to the errant egg...

- is an intended behavior
- is an innate reaction
- lasts for only two weeks
- is a learned behavior

9. If a bell is rung consistently just before food is offered to a dog, eventually the dog will learn to salivate at the sound of the bell. This is an example of...

- operant conditioning
- classical conditioning
- stimuli and response conditioning
- behavioral conditioning

10. According to the article, which of the following is an object that might effectively trigger Geese's egg rolling response?

- red ball
- colorful object
- beer bottle
- big object

11. According to the article, there is a distinction often made between...

- learning and behavior
- learning and instinct
- behavior and attitude
- instinct and behavior

12. Which of the following is NOT one of four factors that govern most animal behavior according to the ethological world view?

- motor programs
- sign stimuli
- motive
- drive

13. According to the passage, the experimental nature of operant conditioning necessarily involves...

- the exposure to punishment of the subject of the experiment.
- the introduction of increasingly greater rewards by the experimenter.
- an increasing refinement of behavior on the part of the experimental animal.
- the use of increasingly subtle cues to trigger the behavioral pattern.

14. The rat example is an example of...

- classical conditioning
- stimuli and response conditioning
- behavioral conditioning
- operant conditioning

15. According to the passage, animals learn a behavior pattern as the result of...

- trial and error experimentation.
- reward and punishment experimentation.
- unconditioned and conditioned experimentation.
- classical and operant conditioning experimentation.

16. The author cites Lorenz, Tinbergen, and Frisch for their...

- studies of the egg-rolling response in geese.
- pioneering work studying instinctual behavior.
- rejection of imprinting as a form of learning.
- use of stringently controlled laboratory settings.

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BIOGRAPHICAL SKETCH

Mrs. Moon J. Lee received her bachelor's degree in mass communications from Kon-Kuk University, South Korea in 1992. After finishing half a year early as an honor student, she decided to broaden her experience through graduate studies in the United States.

Beginning in the fall of 1995, Mrs. Lee's master's degree program in the College of Journalism and Communications at the University of Florida provided a foundation in research where she researched tailored communication in hypertext learning systems. In 1997, Mrs. Lee was the recipient of the 1997 Alec Courtelis Award and an Outstanding Academic Achievement Award from the Office of International Studies and Programs.

Encouraged by her supportive adviser, Dr. Mary Ann Ferguson, Mrs. Lee continued her doctoral program in the College of Journalism and Mass Communications. Through these years, she conducted a series of experiments in new media technologies, health communications and public relations. In 1999, after her internship at Educational Testing Services (ETS) where she helped with research in the development of new media technologies for individuals with visual disabilities, she received grants from ETS as a co-investigator. Furthermore, Mrs. Lee obtained her first two years of teaching experience in the United States, teaching an undergraduate course in public relations research.

In the summer of 2001, Mrs. Lee completed her doctoral degree requirements and signed an employment contract to begin an assistant professorship working toward tenure at Washington State University (WSU).

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Mary Ann Ferguson, Chair
Professor of Journalism and Communications

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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